ELECTRICAL REVIEW
AND
INDUSTRIAL ENGINEER

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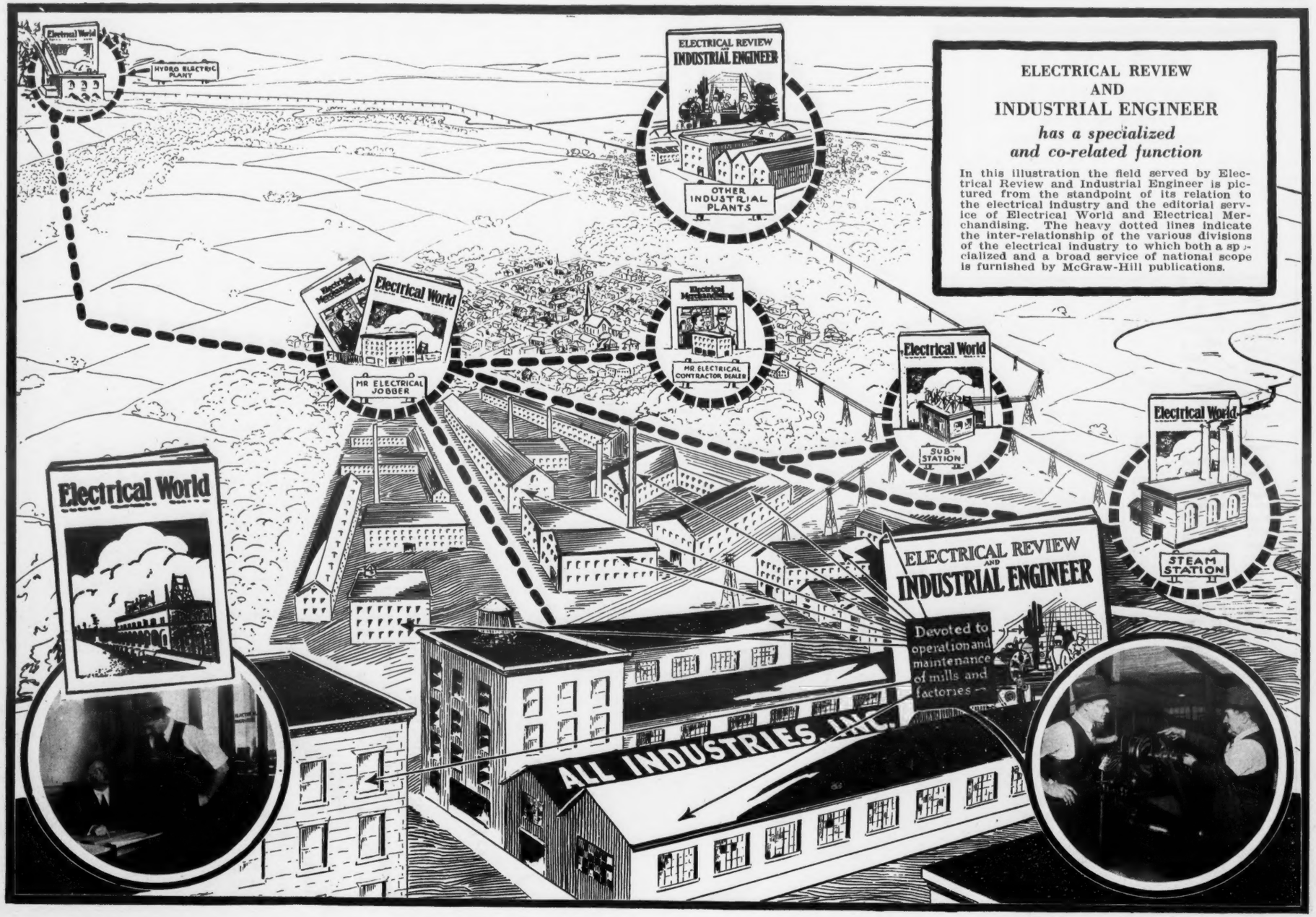
Sponsor for the Average Reader

HELLO READERS! My name is Practical Pete! In our works I am the fellow who seems to be the goat when the other fellows get in trouble. It's because I've had a lot of experience in almost every dpartmnt of small and large works, I guess, and somehow have an intutition when it comes to finding trouble and then curing it. I'm always happy when I have a hard job to do for it keeps my think tank from getting filled with cobwebs. So many fellows just plug along and never seem to realize that they are in a rut when they stop studying out new problems and improved ways of doing things even though they don't fall exactly into the work they have to do day in and day out. Someone has said that a rut is just like a grave, only it's longer and it's about so.

I've got a new job now—the editor of this paper calls it "Sponsor for the average reader," whatever that means. What I am going to do as a matter of fact is to go over the articles in each issue and call attention to some of the practical ideas and improved methods that can be applied in most plants or will help the man who knows how to profit by the other fellow's experience. In other words, I am going to try to show you how to keep out of those ruts and when you get in them how to get out.

When you practical men work out a good idea or would like to see some particular operating information from other plants published as articles, I will be glad to have you drop me a line. The editors of this paper have assured me that this is to be a "we, us and company" journal for the practical man with no highbrow technical stuff to wade through and I am going to hold them to this promise. That's what I understand they mean by "Sponsor for the average reader."

Practical Pete


ELECTRICAL REVIEW AND INDUSTRIAL ENGINEER
has a specialized and co-related function
In this illustration the field served by Electrical Review and Industrial Engineer is pictured from the standpoint of its relation to the electrical industry and the editorial service of Electrical World and Electrical Merchandising. The heavy dotted lines indicate the inter-relationship of the various divisions of the electrical industry to which both a specialized and a broad service of national scope is furnished by McGraw-Hill publications.
Electrical World
HYDRO ELECTRIC PLANT
ELECTRICAL REVIEW AND INDUSTRIAL ENGINEER
OTHER INDUSTRIAL PLANTS
Electrical Merchandising
Electrical World
MR ELECTRICAL JOBBER
Electrical Merchandising
MR ELECTRICAL CONTRACTOR DEALER
Electrical World
SUB STATION
Electrical World
STEAM STATION
Electrical World
ELECTRICAL REVIEW AND INDUSTRIAL ENGINEER
Devoted to operation and maintenance of mills and factories —
ALL INDUSTRIES, INC.

A New Avenue of McGraw-Hill Service

MORE than a year and a half ago the McGraw-Hill Company started a national survey of operating conditions in industrial works under the editorial direction of *Electrical World* and *Power*. From the studies of this survey the character and proportions of operating problems in fast-growing and fast-changing industrial processes have indicated a need for an editorial service more extended and specialized in scope than has heretofore been available. It is quite apparent that these industrial problems divide themselves into two distinct classes, those that are handled by technically trained men and those that are handled by men who may or may not have had the benefit of a college education but are graduates of the institution of hard knocks. On this latter group the leaders of industry depend today more than ever before for the execution of their duties efficiently and with the greatest economy. And it is from the training school which they conduct that the future leaders of skilled workers must come.

AT PRESENT these industrial plant men who are bearing the responsibility for the successful operation of processes of production, electrical and mechanical, there is no well recognized title that gives them a group status in the particular kind of work in which they are engaged except that their education and training admits them to one of the several engineering organizations.

The time has come when the skilled industrial man, who is doing the thinking for a group of workers and supervising their work, should have a title and a standing recognized by the engineering profession and by industrial employers.

TO THIS GROUP of men the title of Industrial Engineer is more inclusive than generally used and applies to the plant superintendent and his electrical and mechanical assistants, the chief electrician, the master mechanic, the head of the repair shop, the head of the stock room and the head of every other department and its subdivisions who is carrying real responsibilities in plant operation and maintenance.

THE OPPORTUNITY of the business press dealing with engineering problems to study, to analyze and to formulate, the industrial operating problems of electrical operation and maintenance in mills and factories from the standpoint of these practical men, furnished the basis for the purchase of the *Electrical Review* and renaming it the ELECTRICAL REVIEW AND INDUSTRIAL ENGINEER, of which this is the first issue. There is no doubt that the high standards of the products of American industries can be accounted for, partially if not wholly, by the scientific and technical knowledge that has been applied in their development. If, then, to the operating or manufacturing side this same practical assistance is accorded, sound economic principles rather than expediency will prevail in perfecting industrial processes where responsible supervision of many skilled hands and eyes is essential. For these reasons the ELECTRICAL REVIEW AND INDUSTRIAL ENGINEER, in dealing exclusively with the operation and maintenance of electrical and mechanical systems in mills and factories, will render to practical men a service not heretofore provided by McGraw-Hill journals. The *Electrical World* will continue to cover, as in the past, industrial engineering problems from the technical standpoint of research, design and installation.

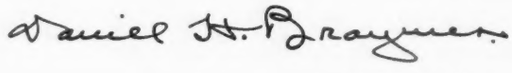
THOSE READERS who subscribed to the *Electrical Review* under its former management and are not associated with industrial works are given the opportunity to transfer their subscription to *Electrical World, Electrical Merchandising, Journal of Electricity & Western Industry* or *Power*, as may be desired.

Through these five publications an extended and correlated service will be furnished to the specialized as well as the broader phases of activity in the electrical industry.

The Editorial Director of Electrical Review and Industrial Engineer in the following statement, outlines the

Editorial Plan and Its Scope

To an audience of supervising mill engineers and factory department heads who are carrying real responsibilities in the operation and maintenance of electrical and mechanical systems, Electrical Review and Industrial Enginer will bring practical ideas and information dealing with the fundamentals of good practice rather than theory. It will aim to have a human touch and above all, it will be tempered with that rare something which elevates a skilled and experienced operator from a job to a position and is known as applied common sense.



Editorial Director
Electrical Review and Industrial Engineer

MOST OF US who were reared in or near a city of average size can recall the modest beginnings of what now are extensive industrial works. Starting with a small plant in which one or two men controlled all operations, mechanical, financial and sales, step by step new and larger departments have been added with more workers and a better, larger and more diversified output. Such expansion has called for an operating organization with distinct divisions headed by specialists in a definite line of work assisted by supervisors skilled in the manipulation of machines and the handling of workers. In fact, many of the present generation can survey the development of extensive divisions of entire industries; such for instance as is embraced in the electrical industry, including the manufacture of electrical power equipment, manufacture of electric lamps, manufacture of electrical supplies, control equipment, telephone apparatus, electric railway equipment; and in the automotive industry with its wide line of accessories; airplane manufacture and the like. These industrial works have created other extensive subordinate industries, producing the raw material and parts required, such as wire and cables, resistance material, electrical steel, nonferrous metals and alloys, electrical porcelain, rubber products and a vast array of individual units produced in enormous quantities.

IN THE rapid development of these and other associated works there are innumerable instances where operating practices and procedure in manufacturing processes have not kept pace with the scientific and technical engineering side of the business. This is to be expected owing to the fact that in the evolution of industrial processes, research and the technical details have demanded first attention. There is always the desire or the compelling force of competition to improve and refine the product made while improvements and refinements in the production of raw material and working it up into various products, entailing new investment and the analyzing of routine work in processes and departments on the basis of unit costs to meet changing conditions, are developments that have usually followed expansion programs rather than proceeded them. In spite of the backwardness of the management of industry to study its routine operations and its methods so as to bring the supervision of processes and efficiency of department practices up to the standard of efficiency in technical and strictly engineering departments, great works have grown like mushrooms. Of late years, however, it has been learned that intensive study of operations should accompany plans for plant growth with the result that certain operating principles have been laid down that assist in continuously improving the efficiency of production organizations and eliminating waste of human effort and materials as well as furnishing a definite basis for controlling costs.

IN THE manufacture of any product three essential elements are envolved—raw material, labor and energy in the form of heat or of electrical and mechanical power. The relation of these elements in the extent they are required depends upon the kind of product and the conditions under which it is produced. Several plants making similar articles will show variations in the output per operative and the profit per unit produced, depending upon the completeness with which the operations have been studied from a production economy standpoint.

THE DEGREE to which energy in its various forms is used in the production of raw material or the manufacture of a finished product measures the extent to which man has used his ingenuity and intelligence in harnessing the assistance of material forces. When hand operations can be replaced by mechan-

ical or electrical operations the speed of production is increased, providing more work of a higher type of duty.

THE WORK of the Society of Industrial Engineers along this line, together with the studies of consulting engineers specializing in industrial engineering, have done much to direct the attention of the management of industry toward better production methods and systems for cost finding. There is, however, left the great field of training the industrial worker himself in the technique of his work, giving him the "how to" information necessary to carry out the methods laid down as most efficient for the processes involved, teaching him the importance of the continuity of service, how troubles can be obviated by adequate inspection and testing and in general, helping him to become more familiar with the machines and systems under his supervision and control.

In this connection an engineer of a large steel mill recently made the following remark:

"Years ago we all used to rebuild electric apparatus every Sunday. We did not think anything of taking out ten or twenty armatures each week. We worked double time and thought we were lucky if we kept the mill running all of the week. All this has changed and we are running motors for years at a time. The only reason we take out armatures now is because bearings are wearing out. I think this improvement is mostly due to the better class of motors which we are receiving from the electrical manufacturers, also to the better control, the higher grade of brushes and to the fact that we understand the machinery better. I think our method of inspecting machinery is often wrong. An inspection of machinery does not mean to wait until repairs are needed. We should inspect the machine and put

Scope of the Editorial Plan

THE ELECTRICAL REVIEW AND INDUSTRIAL ENGINEER will be a paper for the practical man, devoted to the operation and maintenance of electrical and mechanical systems in mills and factories.

It will discuss the practical problems of mill engineers and factory superintendents, their assistants and the heads of departments in adapting electric service to production processes, and in organizing and maintaining such procedure in inspection, overhauling and repair as represents best practice in different types of industrial works. It will also deal with the operating problems of interest to the industrial men who are studying the changing from mechanical to electrical operation of plant processes.

In the editorial treatment of articles, practical methods in handling installation work, in repairing equipment and in maintaining continuity of service in existing works, will predominate over the engineering considerations involved in the design and layout of equipment in new buildings. The viewpoint of the supervising operator rather than the electrical engineer will receive first consideration and the paper will talk his language rather than the technical language of the electrical and mechanical engineer.

When the installation of electrical systems in mill and factory buildings is discussed it will be from the standpoint of both electrical and mechanical engineering practice, considering the service requirements from the viewpoint of the supervising head responsible for the inspection and maintenance of the systems involved.

Outline of Topics that will be discussed

(1) Organization of inspection and maintenance departments.

(2) Practical information and procedure essential in the inspection and maintenance of industrial electrical equipment.

(3) Scheduling and handling of work in repair shops.

(4) Procedure in overhauling and remodeling existing systems, both mechanical and electrical.

(5) Problems in layout and installation changes of lighting and power wiring.

(6) Details of methods and schemes for handling installation changes in electrical and mechnical systems.

(7) Practical schemes used in making changes in electrical and its associated mechanical equipment to improve operation, to reduce operating and maintenance costs, to protect men and machines and to formulate standards of practice under different conditions.

(8) Tests to determine the power requirements of machines in different industrial operations.

(9) Studies of operating costs and of the apportionment of the cost of electrical energy used in different industrial operations.

(10) Details of methods of using instruments and tools essential to the making of tests and repairs.

(11) Analysis of stock keeping methods that are essential to the adequate maintenance of plant equipment.

(12) Operation and maintenance of special processes that depend upon the successful application of electrical energy, such as heat treating, electric welding, electric furnace applications, electroplating, etc.

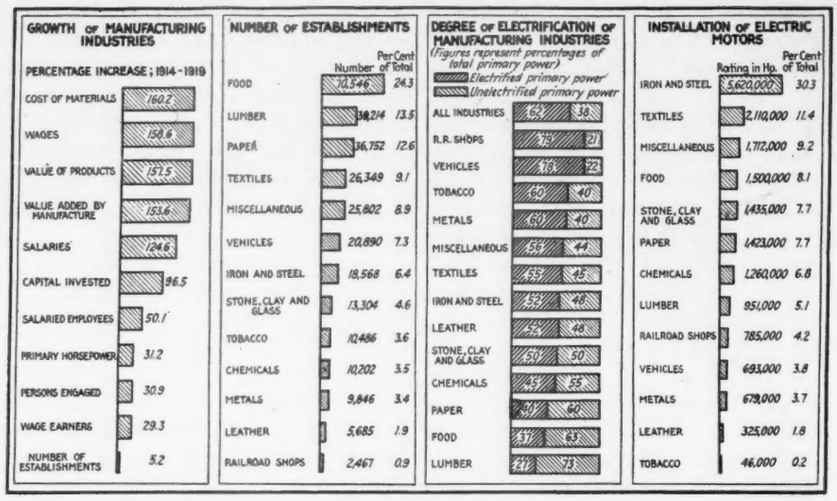
(13) Studies in industrial lighting from the standpoints of maintenance of existing systems and changes to meet the illumination requirements of department processes.

(14) Analysis of improved operating practices in the handling of materials from their raw state to the finished product.

(15) Analysis of service requirements, testing and maintenance of factory signal system, such as telephone, fire alarm, watchman and time clock and special calls systems.

Almost two-thirds of the primary power in industrial plants of this country is electrical.

These diagrams show the marked growth in the use of electrical energy by the industrial plants of this country. They are based on figures issued to date, which were obtained by the Federal Government in its Census of Manufactures taken at the beginning of 1920. In 1914 for 22,533,374 hp. of primary power there was installed 8,847,622 hp. of electric motors. In 1919 this primary power had increased to 29,573,207 hp., and it is estimated that of this primary power about 18,539,000 hp. must be credited to installed electric motors. Expressing the conditions in another manner, in 1914, 39.3 per cent of the power used in manufacturing processes was electrical, while in 1919 the ratio is estimated at 62.7 per cent.



it in good condition before it breaks down. If we find that certain apparatus is causing more delay than it should, we send a man out to investigate and find out what the trouble is. We often find the trouble due to the machinery running too fast, being overworked, or to the manner in which it is handled."

IN DEVOTING this publication to the operation and maintenance of electrical and mechanical systems in mills and factories, the viewpoint of the editors will be that of the skilled industrial man who is in charge of the supervision of a group of men and instructs them in the handling of their routine work rather than the viewpoint of the engineer-executive talking to other engineers possessing a knowledge and familiarity of industrial operations.

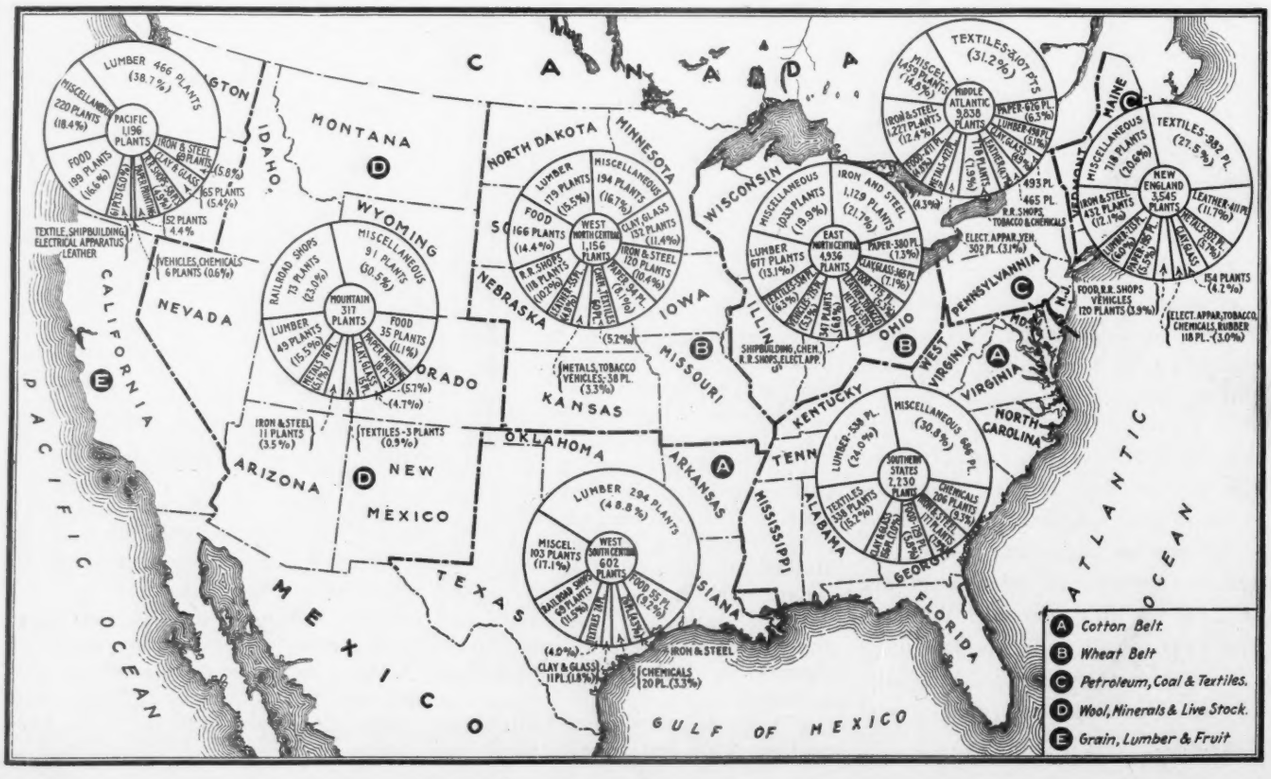
It is to John Doe and the men who work with him, directing and controlling the operations of the industrial works, that the editorial contents will be directed. It will be inferred that these men have the following duties:

(1) They must see that equipment operates without interruptions under all conditions. Allowances for interruptions have (*continued on page 55.*)

Manufacturing Plants in the United States According to the 1919 Census

Section	Total number of plants	Total plants having over 50 employees each
New England	25,531	3,545
Middle Atlantic	88,413	9,838
South Atlantic	29,996	1,590
E. N. Central	61,337	4,936
W. N. Central	22,767	1,156
E. S. Central	14,695	640
W. S. Central	13,909	602
Moutain	7,612	317
Pacific	19,568	1,196
Total	289,768	23,820

This map shows the distribution by sections of the country of the 23,820 industrial works that employ more than 50 workers each. The total number of such works is 289,768.



A. C. ROE

explains step by step

How to Wind Fractional-Horsepower D.C. Motors

Just what to do from the start to the finish of the winding job when it is handled by an experienced armature winder together with recommendations for adequate insulation under different operating conditions.

MR. ROE has had unusual opportunities to study motor winding operations in the repair shops of the Westinghouse Electric & Manufacturing Company. After several years' experience in the East Pittsburgh and New York shops, he was recently appointed shop superintendent of the Detroit service department of that company.

WHEN winding direct-current fractional horsepower motors there are a number of points which must be watched carefully to make sure that a good job will result. The winder must know what data to take from the old winding, how to insulate the slots, what wire to use, how to put the coils in place and how to connect them. In this article these steps are explained for straight loop windings. Another article to be published later will cover the details of split-loop and layer windings.

Taking Required Data from the Old Winding

First of all before an armature is stripped for rewinding, the winding data should be taken from the old winding and recorded in a note book or special data record and kept on file for checking the finished winding. If possible, get the name-plate rating of the motor, count the number of bars and slots, then count the coil pitch, and make a note of the type of winding, whether split, loop, etc. If it is thought that a different type of winding will make a better job, note this on the sheet. Next locate the last coil wound in and take the lead data, putting it down in the form of a sketch as in Fig. 6 (lower drawings only). Use a piece of string to line out from the slot to the bar. Next measure how far the winding projects from the core on the end and also the distance the commutator is pressed on the shaft. Then remove one coil, unwind it, count the turns per coil and check the size of wire and kind of insulation, noting whether it is double-cotton-covered, etc. Be sure to get these data correct and to note any special features of the winding before it is discarded.

A good method of removing the old coils from the core is to cut the wire at the commutator end of the armature with heavy shears. If wedges are used to hold the coils in their slots, these should be driven out if possible with an old hack saw blade and hammer. The teeth will catch the wedge and drive it out. If the core is warmed up a bit with a gas torch, the wire will come out easily. They can be pulled out a few at a time from the end of the slot. Before putting on the new winding, the old insulation must be cleaned out of the slots by scraping and burning with a torch. Then blow out each slot thoroughly with a blast of compressed air. It is sometimes necessary to brush the slots with a boiling solution of caustic soda to soften the old insulation. If the commutator is to be used again it should be kept out of the solution. The armature should be baked and allowed to dry after stripping and before putting on the new winding.

Fig. 1—Straight loop winding.
Commutator is on other end. See Fig. 4 for same motor.

Insulating the Head and the Shaft

If the fiber head and the shaft insulation have been damaged, they should be replaced. To take the place of the fiber head, washers should be cut to slip over the end of the shaft and fit against the head of the armature. These should be of such a size that they will rest against the bottom of the slot insulation. This will take considerable strain off the corner of the slot insulation and help to prevent grounds. One thickness of 1/16-in. fiber should be put on in this manner.

For insulating the shaft, some material that will allow the wire to slide easily, such as fishpaper, or treated cloth should be used. Four layers of this should be put on, using plenty of shellac. Liquid glue should never be used. Dry or pot glue may be used, though it is not recommended. To make the wires slide easily over the shaft insulation, it may be rubbed with parafin after it is in place.

One of the best insulations for armature slots is some form of tough fibrous paper commonly called fishpaper, leatheroid, etc. For 110-volt motors with round slots not over 3/8-in. in diameter and wire not

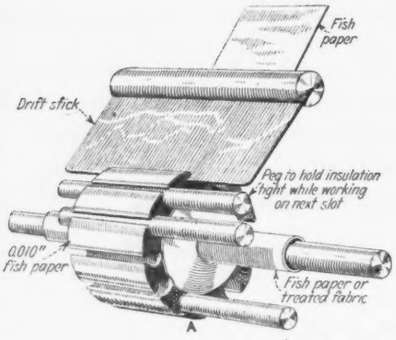


Fig. 2—Slots are insulated with 0.010-in. fishpaper.

A—Where fiber end washer is good one long strip is used.

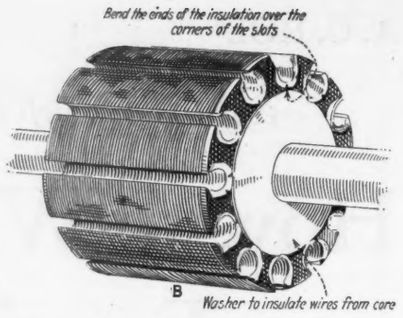


Fig. 3—Insulating slots.

Strips are cut for each slot and bent over at ends to keep wires off of sharp corners of core where fiber washer is damaged.

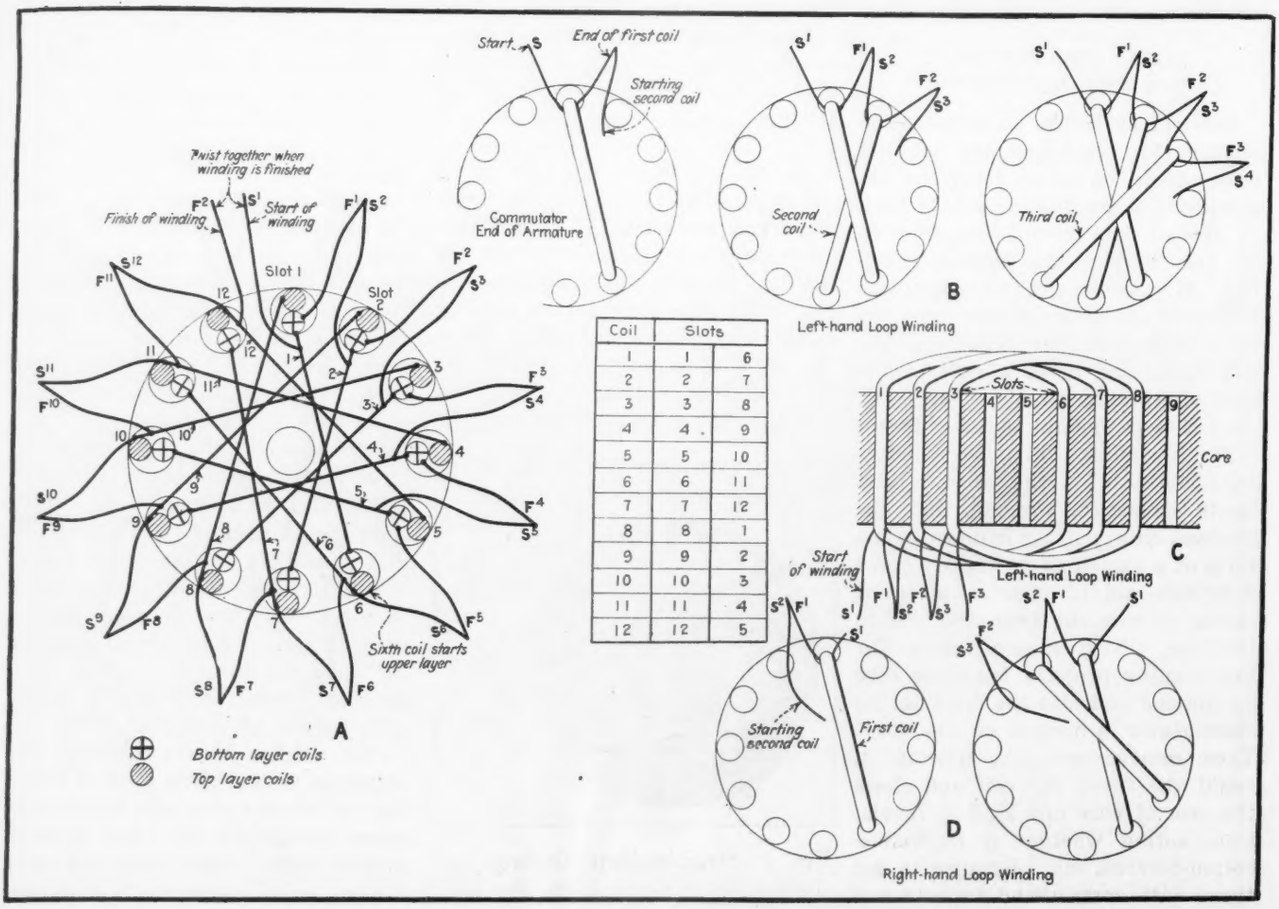
larger than No. 28 B. and S. gage, 0.007-in. or 0.010-in. paper is ample. For 220-volt machines use 0.010-in. paper or thicker. For slots larger than 3/8-in. in diameter and for wire larger than No. 28, use paper from 0.010-in. to 0.016-in. thick. For wires as large or larger than No. 18, use paper at least 0.016-in. thick. It is better not to use two thicknesses to increase the depth of insulation but to employ thicker paper, as the thin paper tears more easily, especially in large slots.

If the fiber head has not been lost from the ends of the armature, or damaged, the continuous-strip method of insulating the armature slots may be used (see Fig. 2). If the head, however, has been lost or damaged, certain precautions must be taken which will be explained later. When using the continuous-strip method, one long strip of insulating material is passed entirely around the outside of the armature slots and looped into each slot. After the winding is put in, this insulation is cut between slots and the free edges of the insulation are tucked over the coil into the opposite sides of the slot in order to hold the coil in place. When the insulation is tucked over in his manner the use of armature wedges over the tops of the coils is not necessary when the armature is to be dipped. But if the slots are not full or the armature runs over 900 r.p.m. fiber or wood wedges should be used.

An explanation of this method of insulating the slots is given in an instruction book of the P. E. Chapman Electrical Works, St. Louis, Mo. The author recommends that the insulation should be cut lengthwise of the grain from 0.010-in. fishpaper. The strip of insulation should be 1/8 in. wider than the length of the slot, including the fiber end washers. It should be long enough to pass entirely around the armature and loop

Fig. 4—How coils are put in place in a loop winding.

A—Shows a two-pole lap, hand wound, left-hand chorded loop winding, for 12 slots, 12 bars and a pitch of 1 and 6. The leads can be put down in one layer and without cutting the loops. S1 is starting lead of coil 1. F is finished lead of coil 1. S2 is starting lead of coil 2, etc. Same motor as in Fig. 1. B and C are steps in winding the armature shown at A. D is a right-hand loop winding of same kind as A, B and C.



Coil	Slots	
1	1	6
2	2	7
3	3	8
4	4	9
5	5	10
6	6	11
7	7	12
8	8	1
9	9	2
10	10	3
11	11	4
12	12	5

into every slot. When starting to insulate the first slot, a loop of the fishpaper is pushed down into it, leaving about 1/2 in. of the shorter end sticking out. In order to hold the insulation tight while inserting in the next slot, a peg is slipped into the end of the first slot, just filling the slot and holding the insulation against the slot on all sides. When the peg is in place, pull the paper tight and rub the paper at the corners where it emerges from both sides with a drift stick, in order to crease it slightly along the edges of the slot. Allowing a little slack over the tooth between the second slot, the insulation is pressed into the second slot with a drift tool, the edges of which are rounded to prevent damaging the insulation. Before pressing the insulation to the bottom of the slot, hold the long end of the strip against the back of the tool and press downward and angularly toward the slot which has just been insulated, so as to crease the insulation over the edge of the second slot. After forming this crease, release the long end of the insulation and press it down into the slot, when it will be found to curl around and fit the slot. The drift tool is then removed and a second pin is inserted in this slot. Before creasing the insulation over the edge of the slot, twist the pin, at the same time pulling on the long end of the paper so as to take the slack out of the paper over the previous teeth. Leave the first pin in place until the second slot has been insulated. Then it may be removed and put in the second slot while the third is being insulated. Only two pins are required, although three are sometimes used.

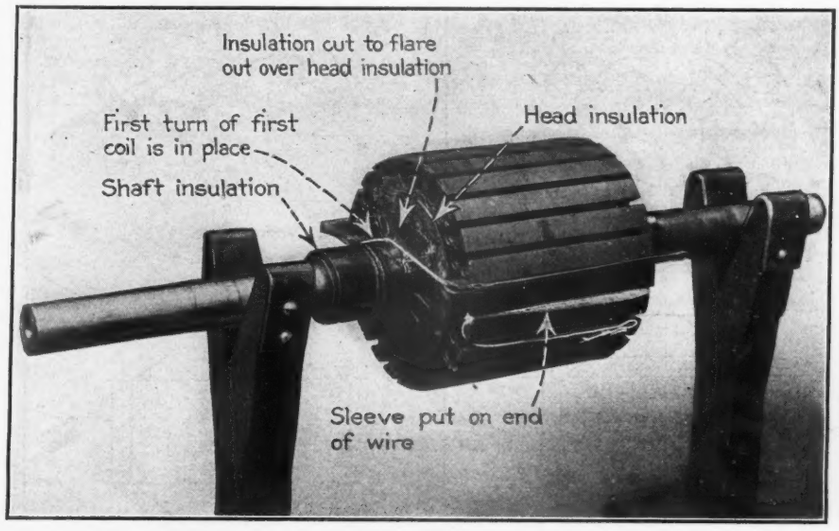
When use is made of the kind of insulating material mentioned and following these directions, it is unnecessary to cement the insulation in the slots as is the case with treated fabric. It is, however, desirable to stick the first and last ends together with thick shellac or some other sticking compound. *Never* use liquid glue. Most liquid glues contain a small portion of acid which will in course of time corrode the wire if the glue comes in contact with it. Dry or "pot" glue may be used as a rule, but it is not recommended and it does not stick to fishpaper well.

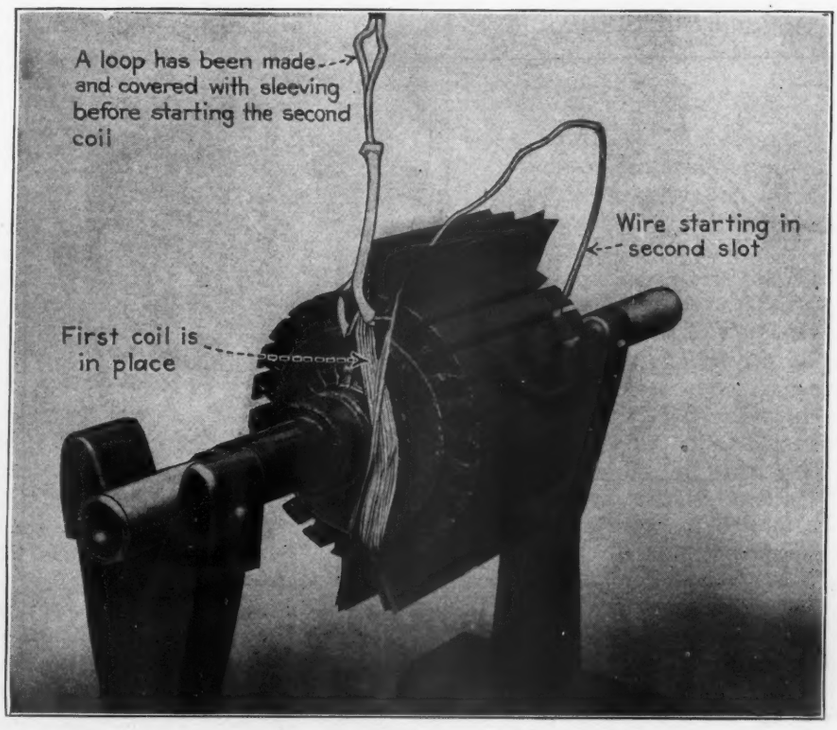
While electrically 0.005 in. to 0.007 in. is sufficient slot insulation, mechanically it is not advisable to use less than 0.008 to 0.010 in. to insure against grounds to the core. In some repair shops a layer of 0.009-in. treated cloth and a layor of 0.004-in. fishpaper is used. Both layers are put in the slot at the same time. The fishpaper is placed inside against the coil and the treated cloth outside against the iron. Where it is desired to use additional insulation between coils in the same slot, strips of 0.010-in. fishpaper may be cut to match the width of the slot and be driven down on the top of each coil in a manner to compress the coil into the slots.

Armatures from which the fiber heads have been lost, either wholly or in part, may be rewound without making new heads if the right method is followed. An insulating washer must be put on in place of the head as already described. After putting on this head insulation, if the slot openings are not too narrow, the previous method of insulating the slots by means of a long strip may be followed by using two thicknesses of insulating material (not

Fig. 5.—Steps in insulating the core and winding the first two coils.

The top illustration shows the start of the first coil with the shaft and head insulation in place. The bottom illustration shows the first coil wound in its slots and the start of the second coil with the loop formed at the end of the first coil and the start of the second one.


Insulation cut to flare out over head insulation
First turn of first coil is in place
Head insulation
Shaft insulation
Sleeve put on end of wire


A loop has been made and covered with sleeving before starting the second coil
Wire starting in second slot
First coil is in place

one piece of double thickness). If the slot openings are very narrow, the following method can be used. Use a thick insulation (see Fig. 3) of 0.016-in. fishpaper or common vulcanized fiber 1/64 in. thick and cut two strips 1/8 in. longer than the slot including the end insulation and just wide enough to entirely fill a slot. In order to determine what this width must be, one piece should be inserted in the slot around a pin or mandrel and marked along the edges of the slot with a knife. Then take out the strip and cut to size. This can be used as a sample for cutting other strips. The strip should be cut so that the grain of the paper runs around the slots, in order to resist tearing. When a strip is put into a slot the end should be pressed open against the end of the slot to form a round shoulder for the wires to rest upon. It is sometimes necessary to stick the insulation in the slots, but often the slots are of such shape that this is not necessary. In winding a motor of which the head has been reinsulated in this manner, too much tension must not be put upon the wire while winding. When using insulation of this kind, it is necessary to close the slot with wedges.

Cotton-and-enamel-covered or double-cotton-covered wires are the best for winding armatures except where the size of the wire is very fine, say No. 28 or No. 30, and finer. They stand a reasonable amount of heating and handling and give good service. Wires with single insulation are suitable only for magnet and field coils, and even there are not suitable when the wire is No. 12 and coarser. Silk-covered wire is delicate, and stands the least heat, burns out quickest by slow roasting and is most expensive. However, silk-covered wire is highly useful where a large number of turns are required of fine sizes, and when cotton would make an excessive volume in the slots. Either silk or silk-enamel should by all means be avoided for armature work on those sizes coarser than about No. 27 or No. 28, B. & S. gage. Above this size they require to be carefully insulated between coils, and sometimes between layers, and, if the armature is small, they will frequently take up more room in the slots than cotton-enamel or even double-cotton wire if the latter is wound on a good winding machine.

Enameled wire, in general, may be considered as equivalent to single-cotton-covered wire. Good enameled wire takes the least room, stands a reasonable amount of handling, a good deal of heat (about 280 deg. Fahr.) continuously, and 80 deg. more for a short while, and is useful in the small sizes for fields and other places where single-covered wire will suffice. Enameled wire should not be soluble in any of the ordinary solvents, such as turpentine, naphtha, gasoline, benzine, linseed oil or its substitutes, machine oil or alcohol. Especially must this be true when using it on armatures. Enameled wire should stand bending without cracking, be tough, and hard to scrape off. It should seldom be used for armature windings without an-

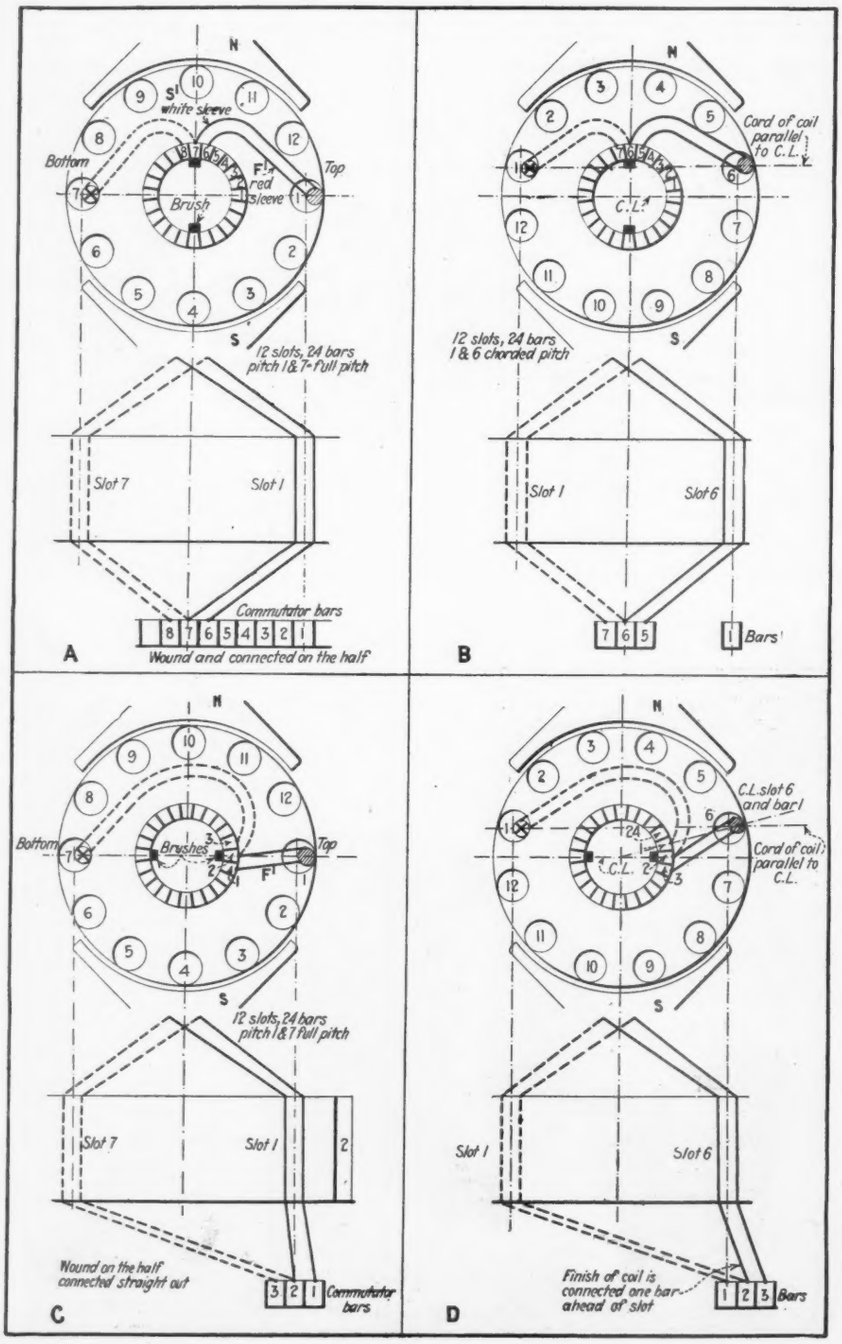


Fig. 6—Don't spoil a good winding job by connecting leads to wrong commutator bars.

Before taking off the old winding a drawing should be made showing the winding methods followed. At A is a full-pitch winding and the brushes are on the center line of the poles. At B the pitch is chorded and the brushes are on the center line of the poles. C shows a full-pitch winding with brushes on the center of the neutral zone. D illustrates a chorded pitch with brushes on the center of the neutral.

other covering, either of silk or cotton. For field work, good enameled wires stand up as well or better than wires with other single insulations.

Good grades of asbestos-covered wire stand the most heat, some manufacturers claim a very high heat, even to redness. The insulation, however, is thicker, and comparatively delicate, and for this reason it is seldom used for armature winding.

Whenever possible armatures should be wound with wire having at least a double covering of insulation. The following table shows the types of insulation that should be used for different wire sizes:

Size of Wire B. & S. Gage No.	No. of Coverings	Kind of Covering
28 and finer	Double-covered	Silk and enamel or double silk
28 to 12	Double-covered	Double cotton or cotton and enamel
20 and coarser	Triple-covered	Two cotton, one enamel or triple cotton

How to Put on a Loop Winding

A loop winding (Fig. 1) is the commonest type of hand-winding and one that is used mostly for fans, vacuum cleaners, drills, grinders, etc. This winding is distinguished from others by the fact that only one complete coil end is visible on either side of the shaft when the armature is wound, this coil being the last one placed. The advantages of this type of winding are that it is quickly applied and connected (when correctly wound) and is the best type of winding to use with armature-winding machines. The disadvantages are that all the coils are not alike, *i.e.*, the first coil is smaller than the last, hence the resistance of each coil is different, and when the turns per loop are great or the size of wire is large the coil ends pile up and are hard and sometimes impossible to wind. The winding is not mechanically balanced due to the unequal sizes of coils.

In Fig. 4, *A* shows how the coils are wound in place for a loop winding. The wire is started in slot No. 1 and is run through slots No. 6 (the pitch being 1 and 6) until the required number of turns are put on, then the wire is brought around to the starting point, and a loop made in the wire as at *C* (Fig. 4). This loop is left long enough to reach the commutator and fit in the commutator slot. The wire is not cut but is continued into slots 2 and 7, etc., in the same manner until the end of the last coil is reached, then the wire is cut and the free end of the start of coil 1 is twisted together with the finish of coil 12.

In Fig. 4, *B* and *D* show the difference between winding left-hand or right-hand. A right-hand winding is shown in *B* (Fig. 4). With the commutator towards the winder the leads are on the right-hand side and the coil is wound inside the shaft. The next coils are wound in the adjacent slots counter-clockwise. For the left-hand winding in *D* (Fig. 4) with the commutator end towards the observer, the leads are on the left-hand side and the coil is wound outside the shaft in a backward direction from the way a man would naturally wind with his right hand, *i.e.*, toward the observer on top. The next coil is wound in the adjacent slot clockwise. A lap-wound armature can be wound right or left-hand or on either side of the shaft without affecting the direction of rotation of the motor or changing the brush polarity in a generator. The term "chorded" means that the coils are not full pitch, which would be 1 and 7 for the armatures shown. The term "loop" is used to denote that the wire is not cut at the start and finish of each coil. The winding in Fig. 1 is a left-hand, chorded loop winding.

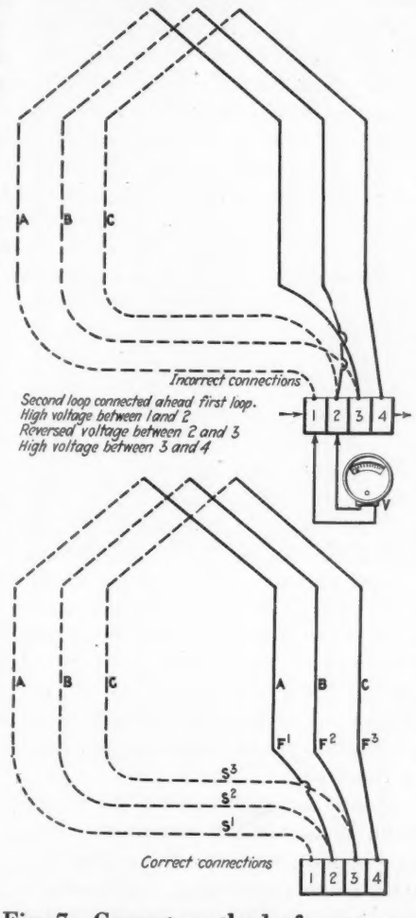


Fig. 7—Correct method of connecting loop winding shown in lower drawing.

Upper drawing shows what may happen if different colors of sleeving are not used when there are more bars than slots.

The winding shown in *A* (Fig. 4) has as many bars as slots, but such a winding can be used for any number of bars. For instance, assume a twelve-slot armature with thirty-six commutator bars and coils having twenty turns per loop. This armature would be wound by starting in slot No. 1 as per *A* (Fig. 4), winding on twenty turns, making a loop and continuing in the same slot. After twenty turns more are put on, a second loop is made and the last twenty turns put in the same slot. After a third loop the wire is passed to slot No. 2 and the same process repeated. In this way each slot would have three loops projecting. When this type of winding is used colored sleeving should be put on the loops, *i. e.*, white on the first loop, blue on the second, and red or none at all on the third. If this is not done there is apt to be trouble when connecting up the armature.

Connecting Up Hand-Wound Armatures

The process of connecting the coil leads of a completely wound armature to the commutator is a very important one, and the peculiar points of each type of winding should be thoroughly understood as a mistake made in connecting will invariably spoil the advantages of a good winding. The majority of motors have the brushes either on the center line of the poles or on the center line of the neutral region. In some few special cases the brushes are advanced or given a backward lead to bring a part of the coil under commutation into a weak field. Fig. 6 shows the combinations usually encountered. These are respectively full pitch with brushes on center line of poles (*A* in Fig. 6), chorded pitch with brushes on pole centers (*B* in

Fig. 6), full pitch with brushes on center line of neutral region (*C* in Fig. 6), and chorded pitch with brushes on neutral center (*D* in Fig. 6). At *A* in Fig. 6 is shown coil 1 under commutation and the leads brought over to the center line of the coil, while the lower view shows the same coil developed. It will be noted that there are two coils per slot, and three bars are connected to the four leads coming from these coils. The two bottom or starting leads connect to bars 8 and 7, while the two top leads connect to bars 7 and 6, bar No. 7 having a top and bottom lead attached to it. This puts the two coils in series. Likewise one coil per cell will take up two bars; three coils per cell, four bars; four coils, five bars; etc.

How to Determine Position of Commutator

To determine the position of the commutator when the brushes are on the center line of the poles, the following formula may be employed: If $pb \div s$ is an odd number, center line of slot should be on center line of mica. If $pb \div s$ is an even number, center line of slot should be on center line of bar; p = pitch, b = number of bars and s = number of slots.

The connection and winding shown in *A* of Fig. 6 is called "wound and connected on the half." A chorded pitch winding with the brushes on the center line of the poles is shown in *B* of Fig. 6. When the coil is under commutation it is in the position shown, *i. e.*, on a chord parallel to the horizontal center line of the shaft. The developed connection is shown in the lower sketch. This type is called "chorded and connected on the half." The position of commutator with reference to slots is determined as in the previous case by formula $pb \div s$, etc.

A full-pitch winding with the brushes on the center line of the neutral region is drawn in *C* of Fig. 6. The developed connections are shown in the lower sketch. This forms what is called "wound on the half and connected straight-out winding," the leads being connected to the bars directly in front of the slot. The position of the commutator in a motor with brushes at the neutral zones between the poles is determined by the following formula: If $(f + p) \times (b \div s)$ is an odd number, center line of slot should be on center line of mica. If this is an even number, slot center is on center line of bar. f = full pitch, p = pitch used, b = number of bars, s = number of slots.

A chorded-pitch winding with the brushes on the center line of the neutral region is illustrated in *D* of Fig. 6. The upper sketch shows the coil in the proper position for correct commutation. In order to connect this coil to the bars that are in contact with the brush, it is necessary to give the leads a slight throw as shown. This is very important, and when connecting or taking data on an armature of this type, care should be taken to get the line-up correct. If the coil was connected to bars 24, 1 and 2, then when slot 6 is in the neutral region and bar 1 in contact with the brush, the bottom half of the coil in slot 6 would be under the pole and in a magnetic field, which would cause sparking at the brushes and heating of the armature. The formula in the paragraph just ahead of this one may be used to get the commutator in the right position.

In some cases where the leads are incorrectly connected, *i. e.*, thrown back so that both halves of the coil are under the poles, one-half under a north and the other under a south, the motor will act as if the coils were short circuited. The armature will tend to rotate and then stick. This is due to the brushes short circuiting an active coil. The foregoing applies to the other types of connections as well.

These examples and Fig. 6 are given to enable the winder to check up his data and to understand the principle of connecting. If in doubt, before connecting, put the armature in the field, then turn it so that one coil will lie in the correct commutating position, which should be on the center line of the neutral region for a full-pitch winding, as shown in *A* and *C* of Fig. 6. With a chorded pitch, the centers of each slot containing a half of the coil should lie on a straight line parallel to the neutral region center line, as in *B* and *D* of Fig. 6. When the coil is in the correct position note which bar the brush is making contact with, mark it, and then bring the leads out to this bar, using it as the center point, as bar 2 in *D* of Fig. 6. A properly wound loop winding is very easy to connect, as the leads are all put down in one layer. The leads can be put down in any position to suit the brush position.

After a motor is connected there are a number of checks which should be made. If the connections are not right, when an attempt is made to run the machine, there will be considerable sparking, the armature will heat up and have a jerky movement. It will tend to stick at each tooth and will develop very little torque. On a shunt or compound motor the speed will increase, the percentage depending upon the error in the connections. With a series motor the armature will run slow and the field and armature will become very hot in a short time. Mistakes are easy to make and cause much trouble, hence great care should be taken to get the winding and connections correct.

An example of incorrect connections which might result from not putting different colors of sleeves on the loops when there are more bars than slots is shown in Fig. 7 (upper). The second loop is connected to the commutator ahead of the first loop. This puts twice as many turns across these bars. The bottom of coil *B* connects to bar 1 to slot 7, top lead to bar 3, to which is also connected bottom lead of coil *B*, which ends in bar 2, so that with a bar-to-bar voltmeter test, the voltmeter measures the drop through two coils. The lower drawing of Fig. 6 shows the correct connection.

Hints for Dipping Enameled Wire

In conclusion it might be well to give some hints on dipping armatures wound with enameled or single-cotton-and-enamel-covered wires. Heat the armatures to about 170 or 200 deg. Fahr., then give them a quick dip (one to five minutes, depending upon the size of the armature) in a thick varnish (never shellac). Allow to drain and then put in a heater. If a thin varnish is used it will have more of a tendency to soften the enamel. The alcohol in shellac will soften the enamel quicker than will benzine or gasoline.

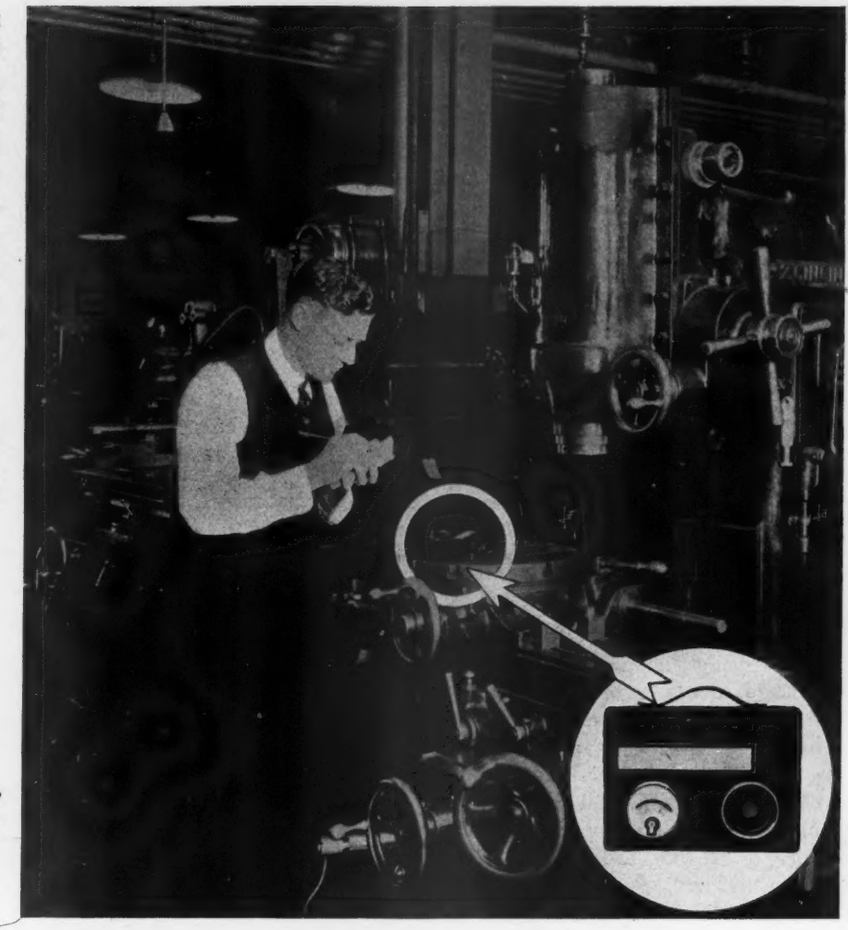
To turn out good armatures learn to wind without excessive pounding at the ends and slots, and watch the insulation at the core ends so that the coils will not become grounded after a short time in operation.

EXPERIENCE has shown that in many factories more than 30 per cent of the light paid for is allowed to go to waste. One-half to two-thirds is being thrown away through lack of attention to simple maintenance requirements. In a plant where the entire time of one man is required the cost of cleaning open reflectors should not exceed three cents each.—*Ward Harrison.*

WARD HARRISON
and J. R. COLVILLE

show how to

Reduce Your Wastage of Light



The foot-candle meter measures light at the work and reveals the combined effect of all possible causes of depreciation.

MUCH may be said of the part that lighting plays in minimizing waste in industry, for the same attributes which resulted in *increased production* at small expense during the days of heavy demand will be utilized to *increase the efficiency* of production where the need is for economy. In the present article, however, in line with the idea of getting the maximum usefulness out of existing facilities, we will deal not with lighting as a whole but with that part which is paid for and not received—the part which, through inadequate maintenance, is lost somewhere between the lamp filament and the work.

To account for the poor attention which lighting systems in factories as a whole receive, it is necessary to infer that most persons fail to realize with what rapidity or to what extent dust and dirt cut down the effectiveness of a lighting system; or that, knowing the extent of the depreciation, they under-value the light allowed to go to waste, or that, with the value of the wasted light known, they believe a maintenance system to be difficult and costly to operate.

Extent and Causes of Lighting Depreciation

In calculating the wattage for a modern lighting system, the illuminating engineer uses a "depreciation factor" to compensate for normal average depreciation in service. Good practice calls for an allowance of 30 per cent more light initially than is expected in service in fairly clean locations and fairly clean operations (23 per cent loss); in dirty locations and dirty operations 50 per cent or even 100 per cent is really necessary (33 1/3 or 50 per cent loss). These figures doubtless seem high, but the illuminating engineer uses them with the knowledge gained from experience that unless the maintenance of the system is handled in better fashion than is usually the case, the system will in a short time be giving less light than it was designed to furnish.

There are six principal causes of lighting depreciation:

(1) Dirty reflectors and lamps.
(2) Darkened walls and ceiling.
(3) Depreciation of lamps.
(4) Empty sockets.
(5) Unobserved burnouts.
(6) Improperly made replacements.

In general, when installed in relatively favorable locations, open reflector units show a depreciation in total light output of from 10 to 25

LAST YEAR Ward Harrison, who is a well known illuminating engineer with the National Lamp Works of the General Electric Company, served as field director of the lighting department of the Lighting Sales Bureau of the National Electric Light Association, established for the purpose of promoting the installation of industrial lighting demonstrations throughout the country. Under his direction demonstrations were established in more than thirty cities which, together with practical talks, have created wide interest in the subject of industrial lighting. Mr. Colville is also associated with the engineering department of the National Lamp Works of the General Electric Company.

per cent in four weeks' time. Where excessive smoke and dust are the rule, the depreciation over this same period may be as high as 40 per cent. The effect of darkening of the ceiling and walls, due to smoke and dust, depends upon the type of unit, the location, that is, whether clean or dirty, and the original color and finish. Typical data are given in Table 1. Mazda C lamps average about 95 per cent of their initial output throughout life. Blackened bulbs are continually decreasing in number, but where inspection shows a bulb to be considerably darkened the lamp should be replaced with a new one. Empty sockets and unobserved burnouts in indirect and multi-light fixtures are frequently found when complaints of inadequate illumination are investigated. Replacement of burned-out lamps with new ones of a wrong size or of an incorrect voltage rating is often found to be the cause for dissatisfaction with the lighting.

When one considers the combined effect of the different causes of depreciation, it is easy to understand why it is that the illumination at the work will often be reduced very seriously in a relatively short space of time. The reason that this waste goes unsuspected is two-fold: First, because depreciation is gradual and, second, because the eye adjusts itself to changes in illumination automatically. Changes in intensity which when brought about gradually pass unnoticed by the eye would be extremely annoying if made so rapidly that the eye did not have time to adjust itself. Usually a falling off of illumination is not apparent until a point is reached where complaints begin to be made of inaccuracies in the work or where the trouble manifests itself in lowered production.

Even then inadequate maintenance is rarely suspected as the cause for the dissatisfaction. A case in point is that of an office lighting installation investigated in response to a complaint. A system of indirect lighting had been installed two and one-half years previously. The ceiling had been painted a flat white and the walls finished in a light buff. At the time the installation was put in the illumination was adequate.

Measurements made in response to the complaints showed that only 2.7 foot-candles were being obtained on the desk tops. A thorough washing of the lamps and reflectors brought the illumination up to 3.7 foot-candles—an increase of more than 35 per cent—and this in spite of the fact that the reflectors had been wiped out at fairly regular intervals. The lamps had been in service more than two years and their rating was several volts higher than the average voltage of the circuit. New lamps of proper rating increased the illumination to over 5 foot-candles. Refinishing the ceiling and walls in their original tones brought the illumination up to slightly more than 7 foot-candles. The effect of the several steps in the restoration process it must be remembered that conditions in factories are unusually severe from the standpoint of dirt accumulation. Experience indicates that more than 30 per cent of the light which is paid for in factories as a whole is allowed needlessly to go to waste. In many individual cases one-half or even two-thirds is being thrown away through lack of attention to simple maintenance requirements.

Value of Light Wasted

If the value of the light needlessly wasted were arrived at simply by calculating its cost in ratio to the

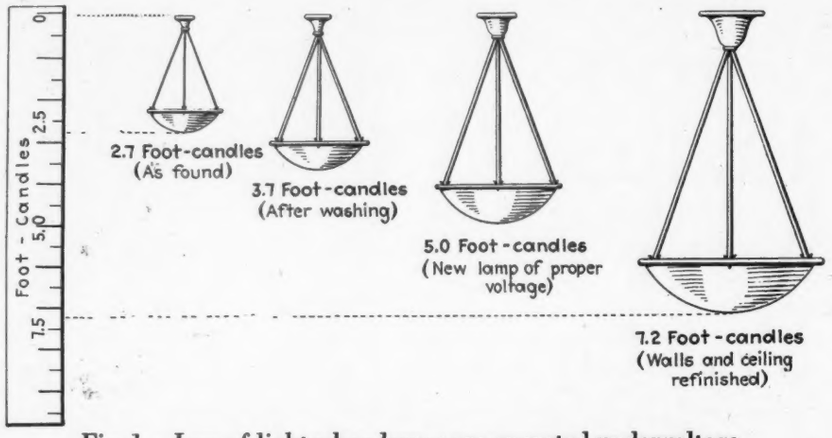


Fig. 1.—Loss of light when lamps are operated undervoltage. The data are for 110-volt Mazda lamps.

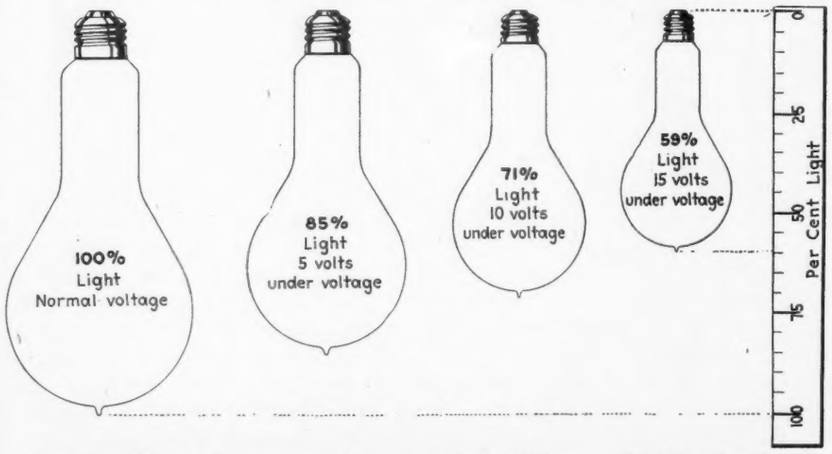


Fig. 2.—Effect of proper maintenance in building up the illumination from a depreciated lighting system. The data were obtained in investigating a complaint on an indirect system.

which increased the illumination from 2.7 to more than 7 foot-candles is shown graphically in Fig. 2.

It is true that unprotected units which have surfaces concave upward invite dirt collection and show a much more rapid depreciation under given conditions than open reflectors of the kind usually employed in industrial interiors. On the other hand total cost of the lighting system, the figures might seem insignificant in relation to the total operating cost of a factory building, for the total cost of the light is itself a small item when so considered. To obtain a correct valuation it is necessary to consider to how great an extent the output of the factory is dependent upon artificial illumination and to

what degree this output is affected by a decrease in the quantity of light.

For a number of years prior to the war, factories had been getting along on just slightly more than enough light to "see." State codes to establish mandatory minimum values of illumination in industry were being talked about because of the need for assuring workmen sufficient light for safety. That light in quantities which would make seeing entirely involuntary, greatly minimize accident hazard, and would make surroundings bright and cheerful, might be employed to advantage in industry was hardly more than a theory. Since that time, experiments* have been conducted which show how vision is improved by increased illumination and tests† have demonstrated that startling increases in production have accompanied improvements in the artificial lighting systems in factories. These increases have been accomplished at an additional cost on the average of only 2 or 3 per cent of the payroll. They are mentioned in this article to show that the light wasted through inadequate maintenance is not simply light over and above that which is needed for efficient operation of the plant. It is light which has an important effect on production, and as such has a potential value far in excess of its purchase price.

Another effect of inadequate maintenance which is almost always entirely overlooked is that of increasing glare and of making shadows sharper and heavier. A bright bulb against a dirty reflector, or a bright unit against a blackened ceiling accentuates glare. The density of shadows depends, among other things, upon the area of the light sources, and where reflectors are dirty their contribution of diffused light is lost.

Systematic Maintenance

Because the rate of depreciation depends so greatly upon individual conditions, it is difficult to formulate schedules which do more than roughly indicate suitable cleaning periods. The schedules of Table 2 are, however, representative of good practice. By far the best check on the illumination is obtained by frequent foot-candle readings at various stations throughout the plant. These readings are easily and quickly made by means of the foot-candle meter, shown in the headpiece. A simple record of readings such as are shown in Fig. 3 will reveal at a glance the condition of the lighting system and will indicate where trouble is brewing before it becomes serious.

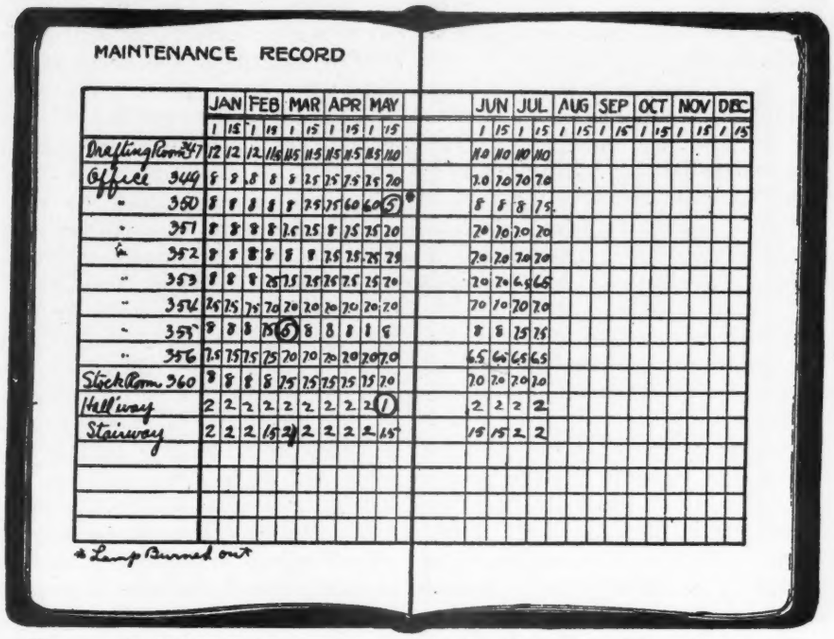


Fig. 3.—Lighting maintenance record taken from the Code of Lighting of the Illuminating Engineering Society.

There is a considerable difference between merely wiping out a unit and washing it thoroughly. The difference is more marked in some units than in others. With the exception of mirrored reflectors, and of plaster or composition units (which are readily cleaned with sandpaper or a stiff wire brush) all require a thorough washing at least as often as every third or fourth cleaning period. Warm water and soap or any of the prepared cleaners used in the bathroom of a home are effective in nearly all cases. Mirrored units require special attention to avoid injury to the backing.

Inspection of lamp bulbs for possible blackening should be made at the regular cleaning period, and if a bulb appears considerably darkened it should be replaced. The cleaning should not be considered complete until the unit has been lighted to insure that it operates. The cleaner should carry a supply of lamps of the proper size and voltage with him so that failures may be replaced immediately.

Where proper cleaning is rendered hazardous because of the difficulty of getting at the units, disconnecting hangers, of which there are several types available, may be used to advantage. Where these are employed,

To Use All the Light Available

[1]

WASH reflectors and lamps thoroughly with soap and water at least every third or fourth cleaning period. See Cleaning Schedule, Table 2.

[2]

FILL empty sockets and replace burned-out and blackened lamps with new ones of the correct size and proper voltage rating. The voltage rating of the lamp should be at least no higher than the voltage at the socket when the system is in use. Avail yourself of the service of the lamp manufacturer in determining what the voltage rating of your lamp should be.

[3]

REFINISH ceiling and high side walls in white or in a very light cream color.

[4]

MAKE some reliable employe responsible for the maintenance of the lighting system and give him sufficient authority to enable him to get the work done.

*Ferree and Rand, Transportation I. E. S., Vol. XV, No. 9, p. 769. Ferree and Rand, I. E. S. Convention paper, 1921. Luckiesh-Taylor-Sinden, Electrical World, Oct. 1, 1921, p. 668.

†Durgin, Electrical Review, March 22, 1919. Harrison-Haas-Dopke, Electrical World, Oct. 15, 1921, p. 763. Stickney and Mahan, General Electric Review, December, 1921, p. 1023.

the work can sometimes be entrusted to employes who could not otherwise safely handle it.

Considerations of appearance often dictate the refinishing of an interior before the expenditure from a lighting standpoint suggests itself. However, the walls and ceiling will have lost much of their reflecting effectiveness before they appear badly in need of refinishing. The foot-candle meter, which measures the combined effect of all possible causes of depreciation, will enable the maintenance men to watch the gradual depreciation as shown on their records and to determine when refinishing is necessary. A white paint or plaster surface absorbs less light than any other interior finish, and the former is particularly adapted to factory interiors. The color of the side walls for the five or six feet next the floor has no material effect upon either the color or quantity of the illumination, and a dark color is preferred because it is restful to the eyes and because it does not show dirt and smudge readily.

The cost of maintaining a system properly is largely one of labor and will, of course, vary considerably. In large industrial plants a small maintenance department is necessary for accomplishing effective results. In small buildings one employe may be able to handle the work satisfactorily. Where the responsibility is definitely assigned to a reliable employe and he is given sufficient authority to see that the work is properly done, the entire routine may be placed upon a systematic basis. In a plant of sufficient size to require the entire time of at least one man, the cost of proper cleaning should not exceed three cents per unit per cleaning in the case of open reflectors. With open semi-indirect or totally indirect fixtures, the cost will be considerably higher. The enclosed semi-indirect units which have recently appeared on the market are slow to collect dirt and compare favorably with direct lighting open reflectors in cleaning. In some cases, it will be desirable to have the cleaning done by window cleaning companies, some of which have established definite departments to handle this work as a part of their regular service.

In conclusion, the definite recommendation is made that the reader take foot-candle readings in a typical interior under the artificial lighting as it is being used at the present time; that the units be thoroughly washed, lamps inspected and replaced where necessary with others of correct size and proper voltage rating; and that new foot-candle readings be taken. The results will show what the possibilities of maintenance are in that particular plant. If a foot-candle meter is not at hand, one may be borrowed from a local lamp dealer.

TABLE 1—Effect of Darkening of Ceilings and Walls on Illumination at the Work

Ceiling:	Very Light			Fairly Light			Fairly Dark	
Walls:	Fairly Light	Fairly Dark	Very Dark	Fairly Light	Fairly Dark	Very Dark	Fairly Dark	Very Dark
Type of Unit	Foot-Candles Illumination in Per Cent							
RLM Standard Dome	100	96	92	98	94	90	94	90
Deep Bowl, Steel	100	96	91	98	95	91	95	91
Semi-Enclosing	100	90	80	95	85	78	83	76
Light Density Semi-Indirect	100	87	76	82	71	63	55	50
Indirect	100	90	83	73	63	57	37	33

TABLE 2—Suggested Schedules for Cleaning Reflectors

Where direct lighting systems are used, i. e., where there are no reflecting or diffusing surfaces concave upward to invite dirt accumulation, the interval of cleaning should be about as follows:

Characteristic of Location	Interval in Days if Units are Wiped out*	Interval in Days if Units are Thoroughly Washed
Very Dirty	3	5
Dirty	7	10
Average	15	20
Clean	30	40

Where open semi-indirect or totally indirect units are used:

Characteristic of Location	Interval in Days if Units are Wiped out*	Interval in Days if Units are Thoroughly Washed
Dirty	5	7
Average	10	15
Clean	20	30

*Washing every third or fourth interval assumed.

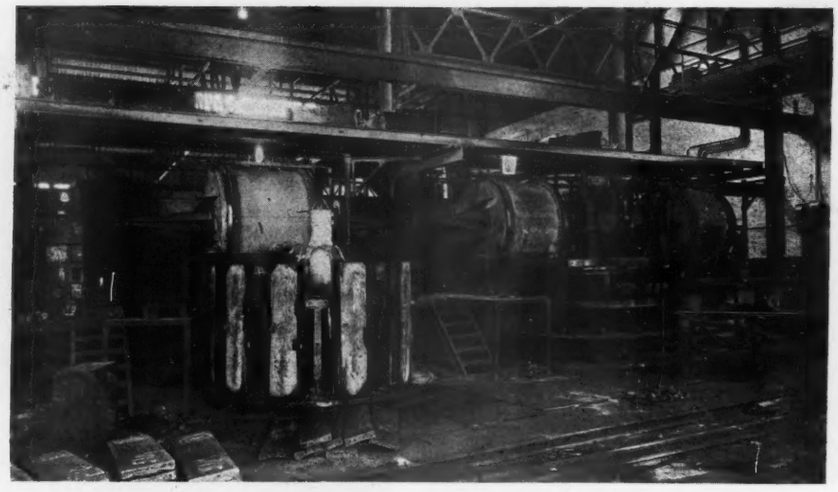
Have You Had to Train Armature Winders?

If you have had to stand over beginners in winding armatures you know how hard it is sometimes to explain all the ins and outs of the process. It takes time and runs up the cost of the job. The article by A. C. Roe in this issue gives this information in such a way that the beginner can study hand winding operations by himself. Many experienced men will find some useful suggestions also. That continuous strip method for insulating the core is something that all repairmen should clip out and put away for reference.

Practical Pete

WITH THE ADVENT of the electric furnace the old time brass melter who has acquired a certain skill of hand and eye through years of experience is giving way to a wide awake mechanic who knows little enough about brass, but who is familiar with the mechanical and electrical characteristics of the machine he is required to operate and can make it perform in any desired manner as directed by his superior.

H. M. ST. JOHN
Service Manager
Detroit Electric Furnace Company



Three of a battery of six 1-ton direct pouring Detroit furnaces at the plant of the Detroit Copper & Brass Rolling Mills are shown here, used for melting yellow brass both for billets and flat metal bars.

The Electric Furnace
as a Metal Melting Machine

Because of its mechanical and semi-automatic features an operator who follows instructions can produce a uniformly high quality of product with less labor and less metal wastage than previously possible—it offers to mechanics a new field for recognition of skill in foundry operations.

JUST how the electric furnace has revolutionized methods of handling non-ferrous metals and materially reduced the cost as well as improved the product, was outlined by H. M. St. John* in a paper he recently presented before the American Electrochemical Society. He pointed out that the atmosphere in fuel-fired furnaces is a cause of much loss of metal. Either there is too much oxygen, and the charge is oxidized, or there is too little, and the fuel is partly unconsumed. Either condition causes a loss in metal as the unconsumed products of combustion attack the molten metal. This difficulty is overcome in electric furnaces. In both the reflected-heat type of furnace and the arc furnace the atmosphere to which the metal is exposed is largely controlled by the presence of incandescent carbon in the resistors and in the electrodes. This carbon combines with the oxygen originally present in the closed furnace chamber to such an extent that free oxygen is practically eliminated before the metal is hot enough to oxidize. In either type of furnace any moisture present in the charge reacts with the carbon to form carbon monoxide and oils present are turned to soot and light hydrocarbons. In the induction type furnace the oxygen present will react with the metal unless it is eliminated, which may be done by spreading a layer of charcoal over the metal.

The rapidly moving atmosphere over the metal surface in the fuel-fired type of furnace carries with it up the stack considerable volumes of metal vapor, principally zinc. It is not uncommon in such furnaces for from 1550 to 6000 cu. ft. of gases per hundredweight of metal to pass over the metal surfaces. This removes the zinc vapor as fast as it is formed and so permits continued vaporization. The stagnant atmosphere in electric furnaces prohibits zinc vaporization. As a result of these factors the electric furnace has unquestionably reduced the average metal loss of all the copper alloys commonly melted in it by at least two per cent of the metal charged. Clean yellow brass is electrically melted at a net loss of from 0.5 to 1.0 per cent, red brass at a net loss of less than 0.5 per cent. These

This is a single-phase electric furnace operated in the Hesse-Martin Iron Works, Portland, Ore., to make cast iron from wrought iron and steel scrap.

*Service Manager, Detroit Furnace Company, Detroit, Mich.

A Booth electric furnace is shown here with automatic electric control.

averages have been maintained in month-to-month operation in carefully operated plants. The fair average net losses in fuel-fired furnaces lies between two and three per cent, although the chances for carelessness in the use of such furnaces is so great that losses as high as 8 to 10 per cent have been found.

Circulation of the Metal

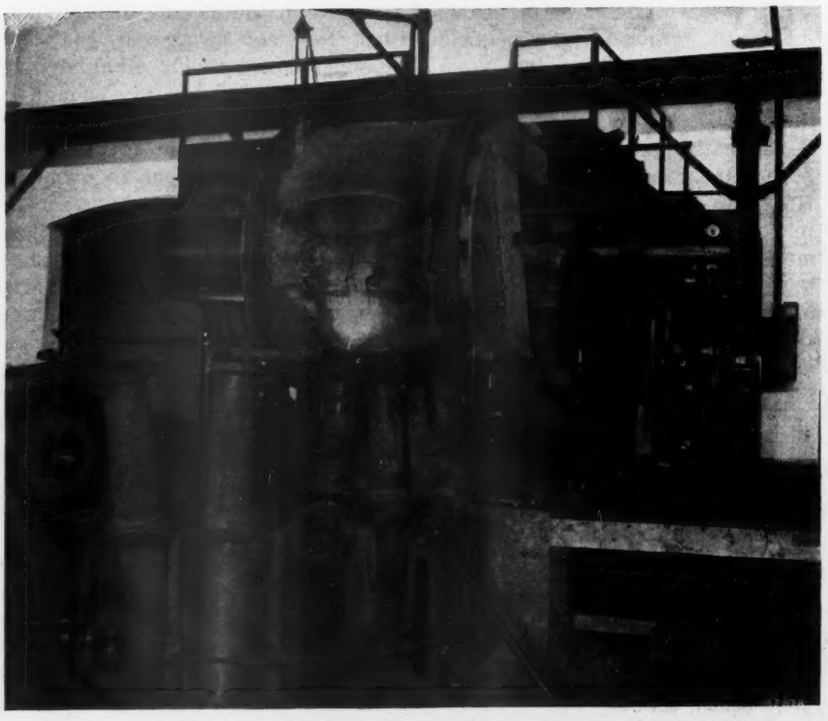
Vigorous stirring of the metal in the course of the melting process has resulted from the use of the electric furnace. This phenomenon is especially noticeable in the cases of the moving indirect-arc and the induction furnaces, although hand rabbling must at times be done in the stationary-arc electric types. Such agitation insures uniformity, lowers the metal losses and increases the thermal efficiency. The thoroughness with which zinc and other constituents mix with the copper is a factor of great importance and reduces the uncertainty of the work. Some large users claim that this stirring is absolutely necessary in the production of the best brass alloys.

Handling Methods

Fuel-fired furnaces do not lend themselves to rapid charging methods. Even large reverberatory furnaces require the use of hand charging methods. Two instances show the time of charging such furnaces: In one it required one hour for three men to charge and make ready a reverberatory furnace of 3,000-lb. capacity, and one man two hours to melt the charge. In the other case three men were required for 1 1/2 hours to charge an 8,000-10,000-lb. reverberatory. Some open-flame furnaces may be charged more rapidly, but better charging methods seem little used.

In electric furnaces, due to the inherent construction, charging is made easy. Those so constructed as to permit charging through the top or through a side door, which may be turned to the top, may be given a charge of 2000 lbs. from a charging platform in five minutes. The use of a bucket or other mechanical contrivance may reduce this time still further. One case was cited where 2000 lbs. was charged and melting resumed one minute and fifty seconds after the last of the previous charge was poured.

In charging any brass furnace it is well recognized that the various elements of the charge should be placed in the furnace in a definite order. It is common practice to charge chips and borings first, followed by ingot and heavy scrap, and finally by light scrap. This facilitates rapid melting and reduces losses. The same practice is fol-



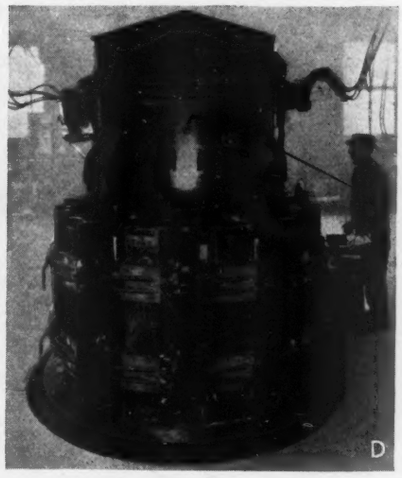
This photograph shows a 1½-ton Detroit electric furnace pouring into billet molds in the plant of the Standard Underground Cable Company, Perth Amboy, New Jersey. The furnace is used to melt copper and high-copper alloys and is charged from the platform shown behind and a little above the furnace.

lowed in electric furnace operation with the exception that it is customary to charge borings and light scrap first, followed by the white metals, then by the rest of the light and heavy scrap, and finally by the copper ingot. In the electric furnace the white metals are included in the original charge, while in other furnaces these must be charged after the rest of the metal is molten. In this way disagreeable and expensive "speltering" is eliminated with a substantial saving of labor and metal.

Methods of Pouring

Metal melted in the crucible is, of course, carried in the original crucible to the sand moulds, billet moulds, or ingot moulds, into which it is to be poured. Metal melted in tilting crucible furnaces, open-flame furnaces, or reverberatories, is poured from the furnace into ladles, from which it is in turn poured into moulds. In all foundry installations this practice is followed with the electric furnace also, but in rolling mills it has become a nearly universal practice to pour directly from the electric furnace into ingot moulds, flat-metal moulds, etc., an arrangement to which the design of such electric furnaces as are used in rolling mills is excellently suited. In one large mill small electric furnaces are picked up by a crane and carried to the moulds, but this is not common practice. A recent development is a systematic attempt to adapt the electric furnace for direct pouring into sand moulds, an attempt which, if successful, is likely to revolutionize pouring practice in the foundry.

Since metal melted in fuel-fired furnaces is not under very exact temperature control, it is common practice to heat the metal in such furnaces to a temperature which the melter feels sure is hot enough before pouring. As a result the metal taken from the furnace is nearly always too hot and must be cooled, before pouring into moulds, by the addition of small pieces of scrap, an operation called "gating the metal down." This practice is extravagant of fuel, increases metal losses and may injure the metal by over-heating, but is necessary where the temperature cannot be accurately gauged in advance. In the electric furnace the temperature is under exact control as the operator



A 105-kw. nose-tilting Bailey furnace pouring directly into rolling mill molds on a casting table.

has constantly before him an indication of the rate of heat input in the form of meters in the circuit. Metal can thus be poured at the desired temperature without overheating to insure a margin of safety.

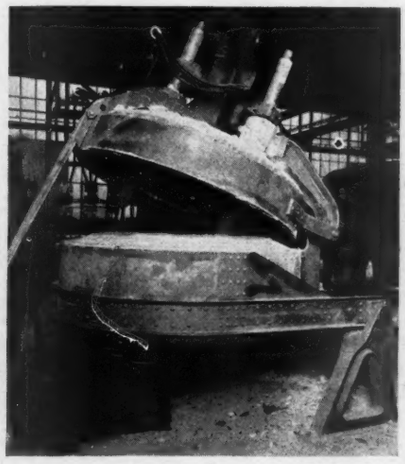
Quality of the Product

There is as yet very little definite evidence to prove the relative quality of the products of the fuel-fired as against the electric furnace. In the rolling mills the opinion is that the electric furnace does produce better brass than the crucible. It can be said, though, that it is easier to produce a uniformly high quality of product with the electric furnace than with any type of combustion furnace. Metal losses are small and very uniform in amount so that a constant analysis is readily maintained. If a clean charge is used there are no particles of oxide to be entrapped and thus produce porous castings. The metal is not contaminated with sulphur or other products of combustion. And the metal can be poured at any desired temperature with remarkable exactitude. If the foundryman knows what pouring temperature will best suit the work in hand he can duplicate this temperature invariably.

As compared with the crucible furnace, whether pit or tilting, an efficient electric furnace of proper design produces at least an equal quality of metal at about half the cost of the combustion furnace. No attempt is made to prove this assertion, but the proof is in the hands of every plant which has used both types. Assuming that this statement is correct the crucible furnace is bound to be eliminated as far as approximately 90 per cent of its use is concerned. In the remaining 10 per cent crucibles will still be used to melt diversified alloys handled in too small quantities to permit efficient electric-furnace use. The fact that in the electric furnace it is possible to produce brass of crucible quality in ton lots would in itself drive the crucible from the stronghold it has had in the rolling mill field.

As compared with open-flame and reverberatory furnaces, the electric furnace produces brass at equal speed, of better quality and at two-thirds the cost. The tendency is to limit the use of these furnaces to low-grade materials from which a low-priced product is to be made. Even in this field they meet with keen electric-furnace competition, wherever and whenever the cost of the fuel they use is high compared to the cost of the electrical energy.

This is a 1500-lb. General Electric hearth type non-ferrous electric furnace, showing the method of lifting the roof. Its rating is 250 kva.



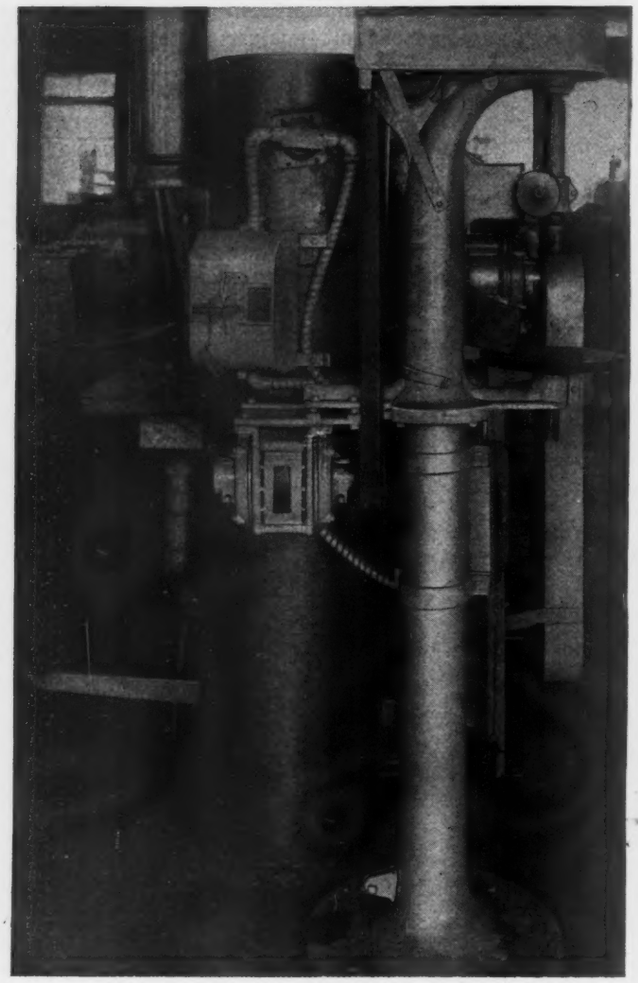
What the Electric Furnace Has Accomplished in Melting Brass

A summary of the influences of the electric furnace in the brass-melting industry has shown the following tendencies:

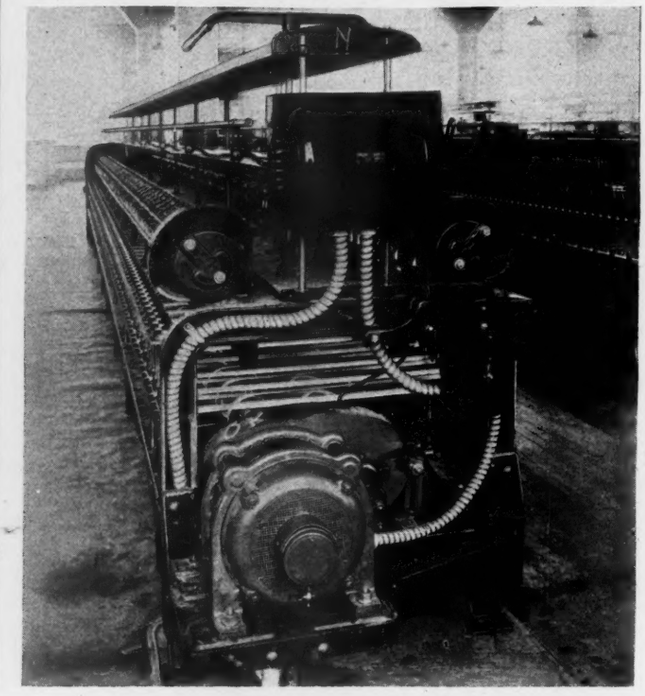
(1) A gradual breaking down of the secretiveness as to methods and results which has marked this industry.

(2) The replacement of the experienced brass melter by a mechanic who may (*continued on page* 54.)

Eight Good Examples of Motor Mountings

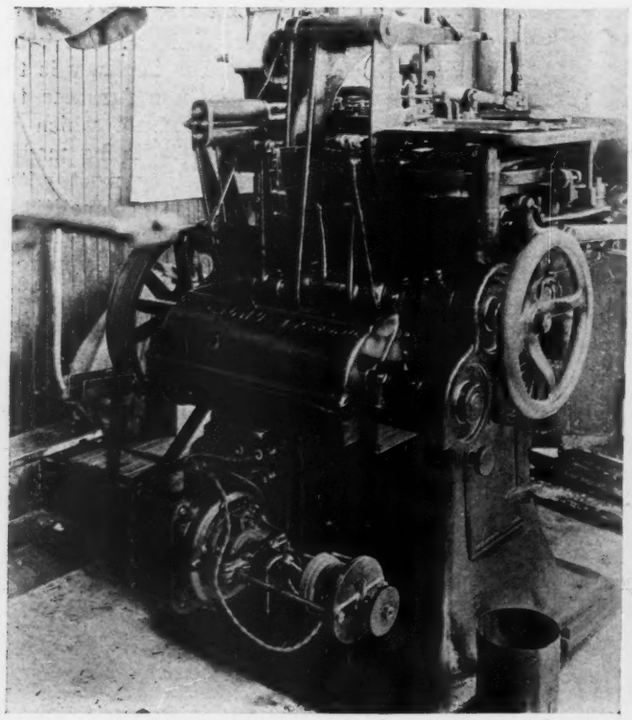


The underslung motor on this drill press is out of the way, yet accessible.

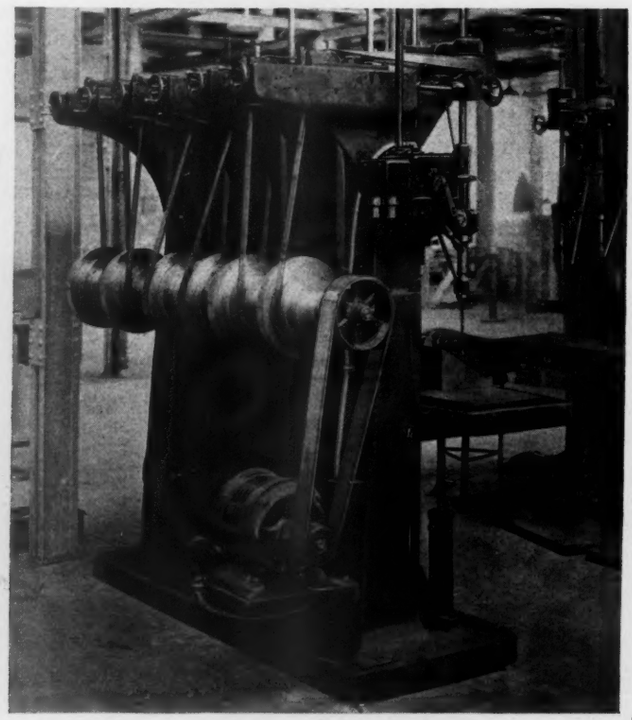


A compact drive with the motor off the floor at the end of a spinning frame. The perforated end plates keep out lint.

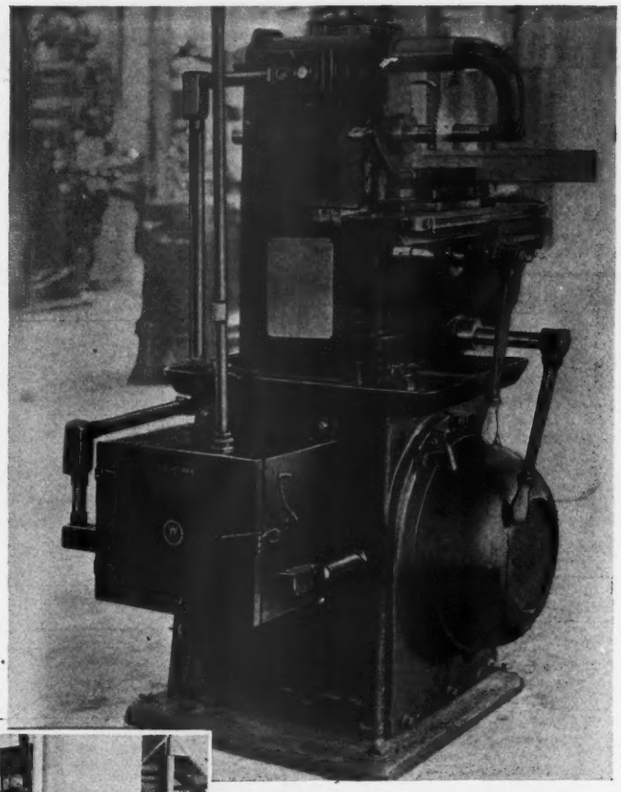
An adjustable-speed motor is mounted on the back of this monotype machine and connected with a short belt drive.



An adjustable bracket raises this motor off the floor back of the machine.



WHEN A MOTOR IS TO BE MOUNTED on a machine for individual drive there are a number of things to consider besides getting the motor and installing it in its place. To insure good service the motor must be mounted out of the way of the workmen and passers-by, in such a location that oil, shavings, etc., cannot fall on it. Its heighth from the floor is another point to consider, so that floor cleaners will not be able to sweep rubbish and dirt under it or into it. Where lint or other fine matter is present, the motor ends should be properly screened. If air circulation around the motor is poor or combustible material is near it, the question of operating temperature should be looked into in case the motor is required to carry an overload during certain periods. Special consideration should also be given to locations near ovens, furnaces or in the presence of acid fumes. Another necessary condition is that the motor must be easily reached for observing the frame and bearing temperatures, gaging the air gap, inspecting and refilling oil wells and the like.

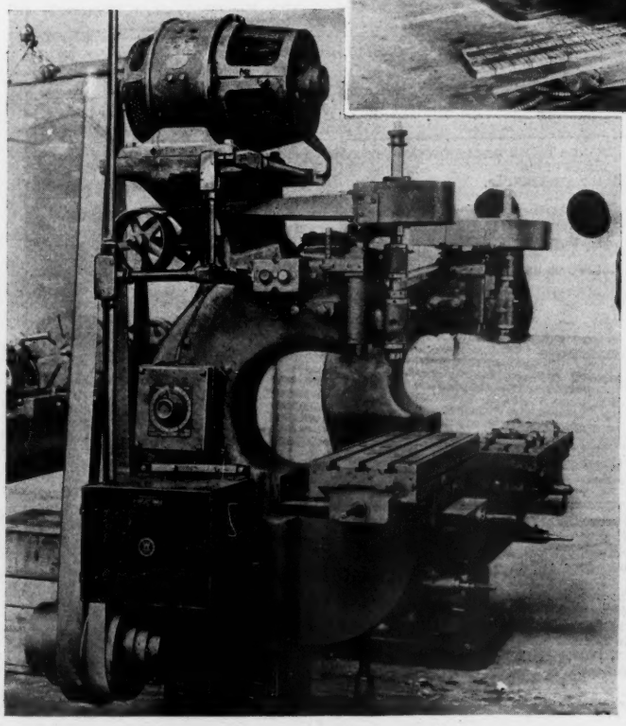


Modern machine tool construction is illustrated in the top view with the motor housed in the machine pedestal.

The motor shown in the center illustration is mounted between two grinders and occupies little more room than a pulley.

Motor mounted above the machine, well out of the way, with service wiring in conduit (lower left).

A direct drive with the motor mounted on a special adjustable bracket, which is clear of the floor (lower right).



Induction Motor Troubles—

Diagnosis and Remedies

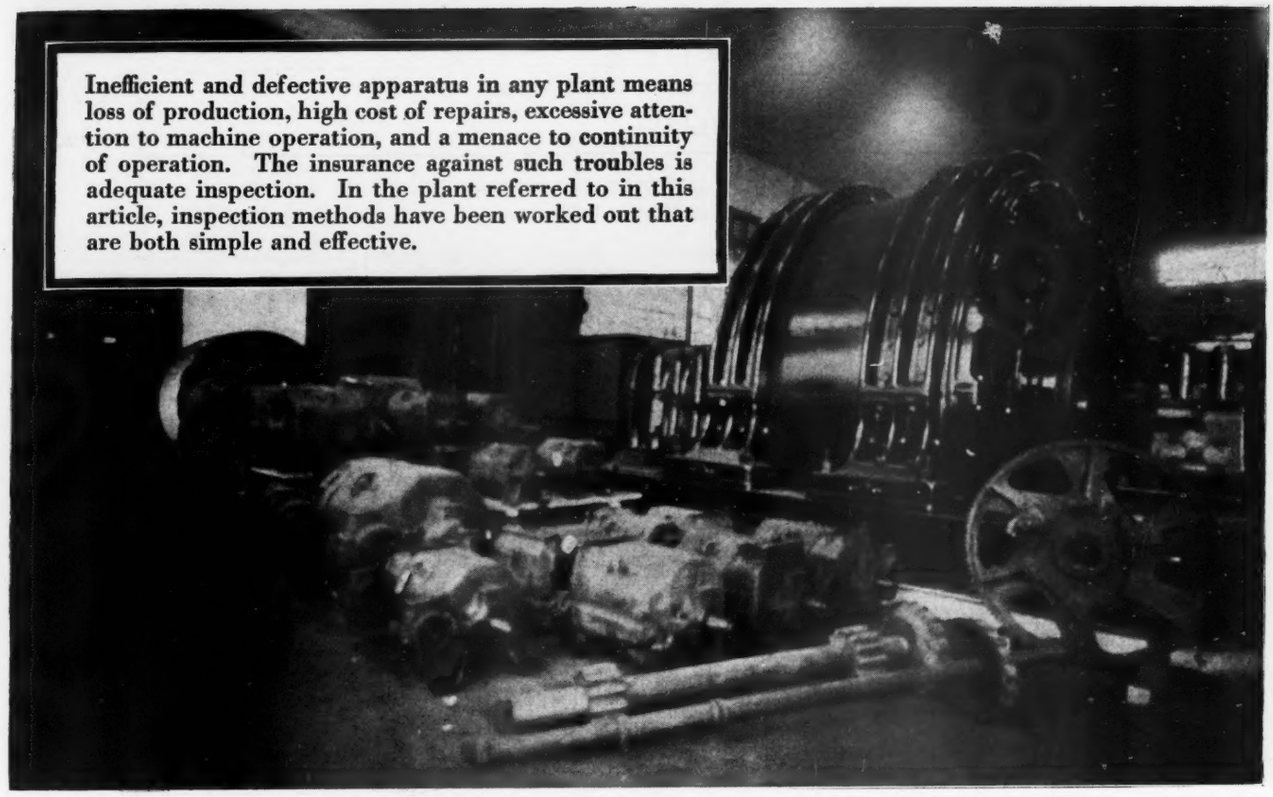
Compiled by H. E. STAFFORD
Electrical Engineer, Provincial Paper Mills, Port Arthur, Ont.

	Symptom	Trouble	Cause	Remedy
1	Bearing too hot to touch, or smoking.	a. Bearing dry.	Not sufficient oil. Oil rings not working.	Refill with clean oil after first washing the bearing with kerosene.
		b. Bearing dirty.	Grit in oil.	Same as above.
		c. Bearing tight.	Cause 1 and 2 above, causing particles of metal to be sheared off and deposited at other parts.	Scrape bearing and shaft or replace bearing.
		d. Oil rings not working.	Rings out of slots.	Replace rings, making sure no metal adheres to sides of slot. If ring sticks or runs slowly, bevel it at either top or bottom with a fine file.
		e. Bearing binding.	Shaft out of true.	Place shaft in a lathe and true and renew bearing.
		f. Bearing out of true.	Too much strain on pulley.	Bearing should be shimmed with pieces of tin, as a temporary measure, or replaced with new bearing.
		g. Loose bearing.	Vibration.	Tighten set screws holding bearing in journal.
2	Bearing hot, but no hotter than other parts of motor.	Heat transferred from rotor or stator of motor.	Overload on motor.	Decrease load or increase size of motor.
3	Smoke issues from windings. Part of windings hot while remainder cool. Wedges over coils charred.	Displaced air gap or rotor not centered in stator.	Bearing worn on one side.	If noticed before coils are damaged, realigning the bearing and inserting new wedges will correct the fault; otherwise coils will need to be replaced.
4	Every second coil in a two-phase motor and every third coil in a three-phase motor hotter than adjacent coils.	a. Not enough resistance in phase which is hottest, causing unbalanced currents in phases.	One or more coils of one phase short-circuited within themselves.	Replace short-circuited coil or "jump" the coil* as a temporary expedient.
		b. One phase grounded.	Dampness or damage by foreign material.	Remove ground by lifting coil and reinsulating. One ground not serious if motor is not overloaded, when delta-connected. If star-connected, there may be unequal currents between phases. If two phases are grounded, a short circuit is the result.
5	Motor runs hot, and on examination it is found the groups of two-phases of a star-connected motor, and the groups of one-phase of a delta-connected motor are hotter than other groups.	Motor running single-phase.	One fuse blown or one overload relay out of order.	Replace fuse or adjust relay and take ammeter readings of each phase.
6	Motor runs hot and explosions, accompanied sometimes by fire, occur in windings.	Temporary ground or short circuit.	Due to dampness which causes circulating currents between coils and between any coil and ground.	a. Bake motor until all dampness disappears and dip or brush with insulating varnish. b. If coils are punctured, replace with new coils. c. If motor is needed at once, the punctured coils can be cut out, if not too many, as a temporary expedient.*
7	Motor runs hot with all stator coils the same temperature.	Motor usually overloaded.	Motor overloaded.	Test each phase with an ammeter, and if readings are high, reduce the load or increase the size of the motor.
8	One or more phases hot in spots, while cool in others.	Part of windings inoperative.	Short circuits between adjacent stator coils.	Replace short-circuited coils, as they will usually be found badly charred.
9	Motor refuses to start with starter handle in starting position, although the motor issues a humming sound.‡	a. Motor tries to run single-phase.	One fuse blown or one overload relay out of order.	Replace fuse or adjust relay.
		b. Air gap displaced.†	Bearing out of true.	Shim the bearing or replace with a new one.
		c. Open circuit in stator windings.	Caused either from a short circuit, which might puncture a coil or from rough handling.	Insert new coil or "jump" the damaged one.*
10	Motor starts and runs, but rotor heats up while the stator is cool.	Abnormal currents in rotor.	Rotor bars loose or grounded.	Tighten set screws holding rotor bars to short-circuiting rings and solder or weld them, and remove grounds. In the more up-to-date types of rotors having cast-on end rings, this trouble is seldom encountered.
11	Motor issues a peculiar sound when running light, as if a heavy load were thrown on periodically with a slight slackening of speed at these intervals.	One coil in one phase reversed.	Due to wrong connection when being repaired or reconnected.	Connect coil to its proper group and in proper polarity.
12	Motor issues a buzzing sound when fully loaded.	Loose connection on rotor bars.	Overheated bars or rings.	Same as for symptom No. 10.

* Care must be used in "jumping" a coil, and the following points should be observed: Where a phase-boundary coil is cut out or "jumped" care must be taken that no interconnection of phases or wrong groups takes place. In one-layer windings, if the insulation is badly burnt, the coil will have to be completely taken out, since, if only disconnected, circulating currents will be produced which will heat up the "jumped" coil and damage adjacent coils. This is due to there being only one coil side per slot. If more coils than one per phase are burnt, care must be taken that there are enough left to offer enough resistance to keep the current low on account of excess heating.

† Where the rotor is not centered in the stator, it is possible that a motor cannot develop sufficient torque, and consequently will not run, although all fuses are intact. The motor will hum and the rotor will probably turn an inch or so. The symptom is the same as that of a motor trying to run single-phase. In a case of this kind insert a feeler between the rotor and stator, and the trouble will show up as an irregular air gap.

‡ The following hints will be found useful in locating the trouble: If a motor does not start, (1) examine the fuses; (2) examine the relays; (3) look over the starter carefully as outlined in a previous article in the ELECTRICAL WORLD, Aug. 6, 1921, page 276; (4) inspect air gap with a feeler; (5) remove belt or coupling, as the case may be, to find if motor is overloaded; (6) test out motor windings with a magneto or bank of lamps. One of these suggestions should locate the trouble, and by applying the proper remedy the difficulty is soon solved.



Inefficient and defective apparatus in any plant means loss of production, high cost of repairs, excessive attention to machine operation, and a menace to continuity of operation. The insurance against such troubles is adequate inspection. In the plant referred to in this article, inspection methods have been worked out that are both simple and effective.

Steel and Tube Mill

Inspection and Maintenance Practices

By ARTHUR J. WHITCOMB

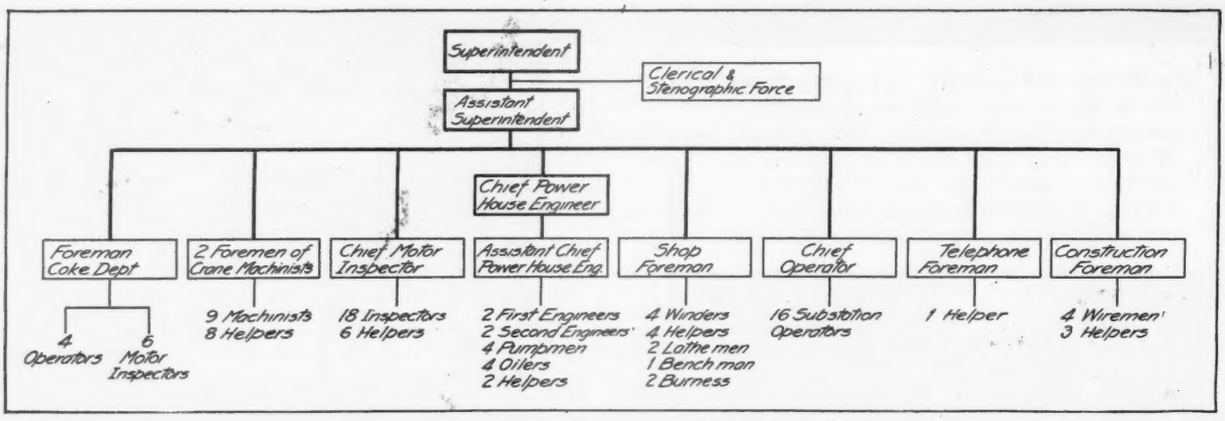
Assistant to Superintendent Electrical Department, Steel & Tube Company of America, Mark, Ind.

CONSTANT supervision and regular periodic inspection, testing and cleaning, all arranged for in accordance with a fixed plan, forms the basis of the program of the maintenance practice of the electrical department in the Mark (Ind.) plant of the Steel and Tube Company of America. Whenever possible advance precautions are taken to secure continuity of operation and a trained force of men is maintained on duty at all times to give immediate attention to any piece of equipment that fails or shows signs of distress.

The entire generator, motor and distribution equipment, together with a great variety of controllers, contactors, relays, meters and other minor apparatus, is operated and maintained by a force of 112 men. An assistant superintendent under the electrical superintendent is in charge of the entire department. All work is divided into groups so that each man may become skilled in his duties and may maintain close supervision over each piece of equipment in his care. Foremen are provided for each group of men so that each branch of the work may be given adequate supervision as to all details. The power house is supervised by a chief engineer and an assistant, with four other engineers, four pumpmen, four oilers and two helpers. A chief operator supervises the substations and the twenty operators in charge of them.

THIS ARTICLE dealing with the general routine work of the electrical department of a large plant will be followed by other articles going into the various details that are presented briefly here as an outline of procedure.

General inspections and maintenance work is carried out by the motor inspectors with their helpers. The motor inspection is supervised by one chief inspector, who reports to the head of the department through the assistant superintendent, the actual work being done by eighteen inspectors and six helpers. This arrangement allows one motor inspector to be assigned to each department of the plant for each shift, with assistants assigned to duty where conditions require. It may be noted here that one foreman, four operators and six motor inspectors are assigned to the coke department,



Organization chart showing the plan by which the work of the electrical department is supervised.

In addition to the superintendent, his assistant and the office force, the department consists of 112 men. There are ten men who rank as immediate supervisors on the job, and 102 workmen. The construction section is expanded at times to provide for the existing construction requirements. Operators working in the coke department are shown under the authority of the foreman of the department because of the fact that the coke department is somewhat removed from the rest of the plant, so that the chief operator is at a disadvantage in supervising these men.

which operates more or less independently of the rest of the plant. Crane equipment is in the care of two crane machinists' foremen working with a force of nine machinists and eight helpers.

A special shop is provided for the repairing of motors and other damaged equipment. This shop is supervised by one foreman, the working force consisting of four armature winders, four helpers, two lathemen, one benchman and two burners.

The rest of the present department force consists of four wiremen, three helpers, one telephone foreman and one helper. The force of wiremen may be greatly extended at times when conditions require. Two telephone men have charge of an automatic telephone system with an installation of 145 instruments.

As suggested by the above organization outline, there is a motor inspector on duty in each department of the plant at all times. The plant is operated twenty-four hours a day for six days a week, regular operation being suspended on Sundays. It is the duty of the motor inspector to keep in constant touch with the performance and condition of the equipment in his department. The general plan contemplates the prevention of breakdowns wherever possible, but when an interruption does take place the motor inspector looks after the required replacements to again restore regular production.

All possible repair work is taken care of during the week, but where repairs can be carried over to Sunday, thus avoiding a production interruption, the weakened equipment is watched and allowed to continue in service. In addition to the daily supervision and repair work that must be done during the operating days of the week all equipment is subjected to a regular systematic inspection, cleaning and overhauling on Sundays. This work is planned for in advance by the head of the electrical department, and records are prepared to show just what is planned and when the work required was carried out.

Maintenance records are kept on prepared forms reproduced as blueline prints from a master tracing, one of the forms being shown in an accompanying illustration. The record (Maintenance Summary) sheets are bound in loose-leaf book form and are held in the office of the electrical superintendent. At an opportune time the superintendent or his assistant makes advance schedule entries on the record sheets by placing circles in the squares under the desired dates and opposite the operations to be performed. The "Period" column serves as a guide in this work, indicating what frequency of repetition had previously been decided upon. These record sheets, marked with circles for future work, are turned over to a stenographer in

"Maintenance Schedule" sheet used to assign detailed work to shop men.

Entries of work to be done on a given week-end are entered on this sheet from the "Maintenance Summary" sheet. Work that is completed is checked off and signed for with whatever remarks are required. The "Maintenance Schedule" sheet is returned to the office after completion of the work. and the circles are checked off with crosses on the "Maintenance Summary" sheet to complete the record of work finished.

Form M779 1M 10-19

THE STEEL AND TUBE COMPANY OF AMERICA

MARK PLANT

ELECTRICAL DEPARTMENT — MAINTENANCE SCHEDULE

MILL Tube — DATE Dec. 11, 19 21

OPERATION NUMBER	DESCRIPTION AND SCOPE OF WORK	COMPLETED AND APPROVED BY	REMARKS, EXCEPTIONS, DIFFICULTIES, SUGGESTIONS
1.	Clean all apparatus	JOP	
2.	Inspect brushes - all apparatus	JOC	New set brushes needed on #10
4.	Clean commutators - all apparatus	JOC	

NOTES

THE STEEL AND TUBE COMPANY OF AMERICA
MARK PLANT

ELECTRICAL DEPARTMENT — **MAINTENANCE SUMMARY**

MILL *Tube*
PERIOD *July 1* TO *Dec. 31*, 19 *21*

O-OPERATION DUE
X-OPERATION COMPLETED

OPERATION NUMBER	DESCRIPTION AND SCOPE OF WORK	PERIOD (WEEKS)	July 3	10	17	24	31	August 7	14	21	28	Sept. 4	11	18	25	Oct. 2	9	16	23	30	Nov. 6	13	20	27	Dec. 4	11	18	25
	LARGE UNITS																											
1	CLEAN ALL APPARATUS	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	INSPECT BRUSHES — ALL APPARATUS	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	OVERHAUL " " "	4	X				O				O				O				O				O				O	
4	CLEAN COMMUTATORS " "	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	CHANGE BEARING OIL	26		X																								
6	CLEAN ENCLOSED END OF REVERSING MOTOR	26			O																							
7	OVERHAUL ROTARY LIFTING DEVICE	6				O						O						O						O				
8	PAINT WINDINGS — ALL APPARATUS	26						O																				
9	TEST AIR GAPS " "	13							O													O						
10	TIGHTEN UP " "	13								O													O					
11	TEST OVERSPEED TRIPS " "	26									O																	
12	TEST INSULATION " "	26										O																
13	OVERHAUL SLIP REGULATOR	12	X												O												O	
14	CHANGE TRANSFORMER OIL	52				O																		O				
15	CLEAN COLLECTOR RINGS	4		X				X				X				X			X				X				X	
	MOTORS																											
31	CLEAN ALL MOTORS	1	O																									
32	INSPECT BRUSHES — ALL MOTORS	1																										
33	OVERHAUL " " "	4																										
34	CLEAN COMMUTATORS " "	1																										
35	CHANGE BEARING OIL	13																										
36	CLEAN AND PAINT INTERNALLY ALL MILL TYPE MOTORS	26																										
37	" " " " " OPEN " "	26																										
38	TEST AIR GAP — ALL MOTORS	2																										
39	TIGHTEN UP " "	4																										
40	TEST INSULATION	52																										
41	INSPECT ALL BRAKES	4																										
42	INSPECT ALL PULLEYS, COUPLINGS, ETC.	4																										
43	PAINT FRAMES — ALL MOTORS	12																										
	CONTROLLERS																											
50	CLEAN ALL MAGNETIC CONTROLS	1																										
51	INSPECT " " "	3																										
52	OVERHAUL ALL MASTERS AND DRUM CONTROLLERS	2																										
53	OVERHAUL ALL LIMIT SWITCHES	13																										
54	INSPECT OPERATION OF MAGNETIC CONTROLS	2																										
55	OVERHAUL ALL AUTO STARTER	5																										
56	CHANGE IN OIL " " "	18																										
	SWITCHBOARDS																											
70	CLEAN ALL SWITCHBOARDS	1																										
71	OVERHAUL ALL CIRCUIT BREAKERS	3																										
72	OVERHAUL ALL OIL SWITCHES	4																										
73	CHANGE OIL IN " " "	26																										
74	INSPECT ALL DISCONNECTS	6																										
75	INSPECT ALL RHEOSTATS	6																										
76	TEST VOLTAGE DROP ON ALL CIRCUIT BREAKERS	4																										
77	INSPECT ALL CONNECTIONS	6																										
78	PAINT ALL SWITCHBOARD STRUCTURES	26																										
79	TEST ALL ROTARY D. C. BREAKERS	4																										
80	TEST ALL ROTARY REVERSE CURRENT RELAYS	26																										
81	INSPECT ALL LIGHTNING ARRESTERS	4																										

the superintendent's office, who summarizes the work to be done two weeks in advance on a "Maintenance Schedule" sheet. This sheet shows the "Operation Number" and "Description and Scope of Work" in columns to the left, the same as on the "Maintenance Summary." It also has a blank space for the entry of the name of the mill where the work is done, and another blank makes provision for the date. Space is provided opposite each operation to

"Maintenance Summary" sheet with one record section filled out.

This record sheet shows the general plan of maintenance for all electrical equipment in all parts of the plant. Each item of regular maintenance work is described and given a designating number in the left-hand column. The period of time in weeks between repetition of maintenance operations is shown in a column to the right of the description of the work. Work to be done is indicated by a circle, as shown opposite operation No. 31 and under date of July 3. When a maintenance operation is completed the circle is checked off with a cross. The sheet as marked up indicates that all maintenance operations on "Large Units" have been taken care of during the 6-months' period.

designate who did or approved the work, and additional space is provided for remarks and notes. With these working sheets (Maintenance Schedules) prepared, having the two columns to the left filled in, and with one or more sheets made out for each mill or department, the general plans for routine week-end inspection and maintenance work are complete.

Week-end maintenance crews of the required size and personnel are

Rack of spare armatures held for immediate use in case of the failure of an operating machine.

This stock of spare parts is supplementary to a supply of complete spare motors held ready for immediate use. The equipment shown, together with the spare motors mentioned, are stored in space covered by a traveling crane so that they may be moved without delay from storage to any point about the plant when needed. Transportation between departments or buildings is by hand or gasoline trucks operating over a standard track system about the plant.

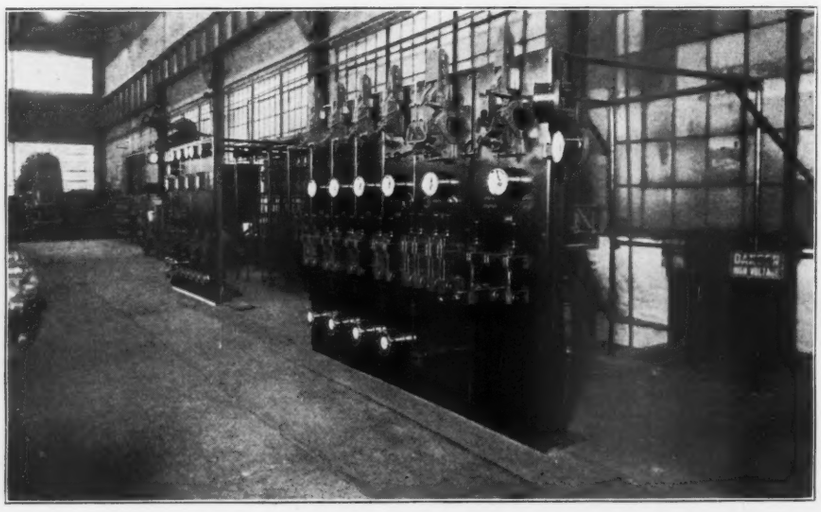
organized from among the men in the department and are assigned on Sunday to the various jobs listed on the "Maintenance Schedule" sheets. As these jobs are completed they are checked off and approved by the man doing the work or by the gang foreman, as conditions require, in the proper column of the "Maintenance Schedule," and where needed special notes and comments are also recorded to call attention to details requiring additional action. All "Maintenance Schedule" sheets are turned in to the office of the superintendent, and from the record shown the circles on the "Maintenance Summary" are checked off with crosses indicating that the various operations have been completed.

By reviewing the completed "Maintenance Summary" sheets it is possible for the man in general charge of the department to see at a glance just how the prearranged schedule is being followed, and by reviewing the "Maintenance Schedule" sheets it is possible to see just who did or approved any particular job and whether anything more is required to be done. Special repair or maintenance work may be ordered, when required, by the superintendent or his authorized representative.

New or repaired motors for replacement, parts, materials, and supplies are available at all times in the electrical stock room. Authorized foremen are supplied with stock tickets for the purpose of drawing any required materials or supplies from stock. These tickets are forwarded by the stock keeper to the office of the superintendent, where record is made in a perpetual inventory. When the inventory record shows a certain low limit of stock of any kind a requisition is made on the purchasing department for additional supplies.

Typical switchboard in one of the ten substations supplying energy to various plant departments.

The equipment here shown controls a 1000-kw. rotary converter, a flywheel motor-generator set, and the reversing-mill main motor shown in the background. The end of the rotary converter shaft may be seen at the left of the illustration. A crane covers the space occupied by the substation, a portion of the track being shown in the upper portion of this view.



Don't Abuse Your Machines

I hate to see a man abuse a machine just as much as I rebel against the mistreatment of animals. For after all the operator who jams a machine through an operation he knows it was not built to stand or does not heed its laboring signals and look for the cause is simply dulling his own sense of duty. The man who can save money for his company by preventing troubles developing in the equipment he uses is the man who can expect to get a part of this in his pay envelope some day. Mr. Causland, in his article on truck and tractor inspection in this issue, has given a lot of information that truck operators and repair men should carry in their vest pocket and refer to until they finally have it tucked away in their heads.

Practical Pete

Treat it right and

Your Industrial Truck

will always be ready for service

By JOHN CAUSLAND

Chief Electrician

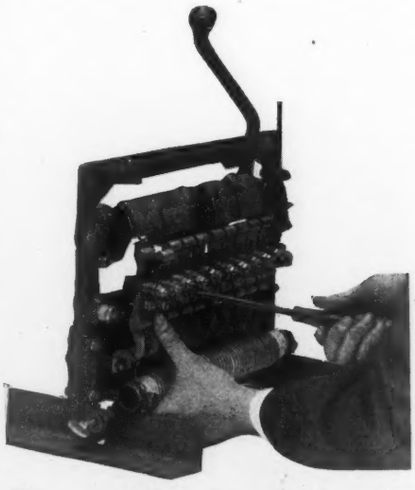
Chicago Terminal Division Pennsylvania Railroad

Just as the Chinese family relies on the physician to prevent sickness instead of curing it, Mr. Causland relies on a careful program of inspection to keep his industrial trucks and tractors in continuous service.

IF you will take care of your industrial truck or tractor, you will find it a willing and powerful servant which will give very little trouble. Starting with the receipt of the truck, you should know what to do before installing the battery, how to put it in the tractor, what points to remember when operating the tractor, how to find troubles and how to cure them. This article is intended to explain some of these things.

New batteries received from either the battery manufacturer or from tractor manufacturers are usually charged, ready to run, but as a precaution it is advisable to give them a soaking charge at one-half the lowest rate, which is shown on the battery name plate or in the instruction book. This charge should be continued until all cells are gassing evenly and freely, and should be discontinued after three consecutive readings taken at one-half hour intervals show no increase in the battery voltage. In placing an old battery in service, practically the same procedure should be followed, except that in the case of the new battery the soaking charge is recommended merely as a precaution, while with an old battery it is almost sure to be a necessity.

In installing a battery in a truck or tractor, it is important that the battery be securely held in place. If the tractor itself is not equipped with some adjustable means for holding the battery, then it may be held in place by wood blocks fastened to the floor of the battery compartment. The purpose of these blocks is merely to keep the battery from shifting, since its weight is sufficient to hold it down. Be sure that no metallic parts of the battery compartment come into contact with the top of the battery so as to cause a short circuit. In connecting up be sure that the battery trays are properly connected together. The last negative pole on one tray should always be connected to the first positive on the next tray. Never connect two negative or two positive poles together. Be sure that the proper lead is connected to the positive pole and to the negative pole of the battery. A reversal of these leads will cause a reversal in charging, which is liable to damage the battery. Most manufacturers mark the leads with the positive and negative signs on small metallic tags. The lead marked "positive" should be connected to the positive terminal of the battery.



The controller does not require much attention but it is important to keep the contactors in adjustment and in good condition.

Regular Daily Charging

Batteries are commonly charged either from direct-current mains with rheostats to regulate the current or from the direct-current side of motor-generator sets driven by alternating current to produce the necessary direct current at the required voltage. Since industrial tractor and truck batteries are used for 24, 30 or 48 volt service, considerable resistance is required to cut 110 volts down to the proper value, causing quite inefficient charging, while with 220-volt current the losses in the rheostat are even greater. On this account a motor-generator set or a suitable rectifier set giving the proper direct-current voltage required by the battery is recommended. For small installations individual sets for each machine, equipped with automatic cut-outs, require very little attention and prove the most satisfactory. For large installations where there is an electrician in constant attendance, larger sets are commonly used. In order to avoid a complete shutdown due to a failure of the charging equipment, it is customary to purchase two units,

A little attention with a grease gun is just as essential for an industrial truck as for any other piece of equipment.

either of which is capable of carrying at least 75 per cent of the total load.

In charging lead batteries, the charge should be begun at the "starting rate" which is shown on the battery name plate and continued until the cells commence to gas. It should then be reduced to the "finishing rate" and continued until the specific gravity of the battery reaches 1.280. This method of charging requires from six to eight hours.

In charging an Edison or nickel-iron battery the current is regulated to the normal rate for the battery and held at that point for seven hours in the case of a type "A" battery and four and one-half hours in the case of a type "G" battery.

Once a week, following the usual charge, it is advisable to give a lead battery an equalizing charge. The charge should be continued at one-half the finishing rate until all cells are gassing evenly and freely. It should be discontinued after three consecutive readings taken at one-half-hour intervals show no increase of the specific gravity of the pilot cell and the battery voltage. With nickel-iron batteries the overcharge need be given only every thirty days. With this battery the overcharge is a charge at normal rate for twelve hours for a type "A" cell and for eight hours in case of a type "G" cell.

Automatic Charging

Automatic charging by means of the ampere-hour meter is becoming very common. In some cases an ampere-hour meter is mounted on the charging panel and arranged so that it will open a shunt trip breaker when a predetermined amount of current has been put into the battery. In other cases where a complete automatic charging system is desired, the meter is mounted on the truck and measures the amount of current which the battery discharges during the day. When the battery is put on charge an auxiliary third wire connection is made between the meter on the truck and the breaker on the panel. In charging, the direction of rotation on the meter is reversed, and when it returns to zero it automatically trips the breaker and stops the charge. Since there is a loss in the battery due to the internal resistance, these meters are equipped with a variable resistor which may be set so that the meter will run slower while the battery is being charged and thus compensate for the loss. The ampere-hour meter used should be rugged enough to stand up under the jars which such instruments receive on a tractor. Types suitable for switchboard work should never be mounted on the vehicle itself.

Loss of power in a battery may be accounted for either by a loose connection, low water in the cells, a leaky jar or by internal trouble. Be sure that the plates in all cells are covered with electrolyte, then test each cell with a voltmeter. If one cell has considerably higher or lower voltage than the others there is an internal difficulty in that cell. In such a case, test across each adjacent pairs of cells with a voltmeter. This will locate a faulty connection in the battery. In some cases it is quite difficult to locate a loose connection between a connector and post. The best way to go about this is to connect up the voltmeter to the terminals of the battery and then to pry up on each connector. When the loose one is found the voltmeter will

Convenience in dissembling for repairs is an essential of truck construction.

show a quick variation in the voltage.

Sometimes this will not locate the trouble. Then it may be necessary to make a discharge test. For this test the battery is given an equalizing charge, or overcharge, and the gravity of all lead cells is adjusted by adding water or electrolyte. Then discharge the battery at its normal rate through a water barrel or other resistance. Voltmeter readings should be taken on each cell every hour, and any readings which are fifty points above or below the average readings show a defective cell.

Battery Maintenance

Aside from replacing broken jars, putting a new cell in a battery to replace defective cells, or repairing loose connections, it is not suggested that battery users overhaul or rebuild batteries without first consulting the local representative for the manufacturer of the battery which they are using.

Very few tools are required for battery maintenance, but a bench on which the battery can be inspected and a chain hoist for lifting it out of the tractor should be supplied. There should also be a hydrometer and convenient method of handling the distilled water. For nickel-iron batteries there is required a filler outfit and a jack and wrench for removing the connectors. For lead batteries a drill for removing the connectors and a lead burning outfit are necessary. A voltmeter also should be kept on hand.

What Parts of the Tractor to Inspect and How Often to Inspect Them

In the table which is included in this article is a schedule to follow in making inspections. The following gives some of the details of methods to use in carrying out the schedule. Tractors should be thoroughly oiled and grease cups should be turned up every day. A thorough inspection should be made at least once a week, at which time any minor repairs and adjustments should be made. In making such inspections the following procedure can be followed:

(1) Remove the controller cover and see that the controller fingers are making proper contact (4 to 6 lb. pressure) with the copper segments on the drum. Test the binding screws on the terminals for tightness. If the fingers and drum contacts show pitting, indicating that the pressure is too light, the fingers and contacts should be cleaned with a file or emery cloth and the pressure increased. If they are badly pitted a light cut should be taken off the drum with a lathe. The drum should be lubricated once a week with a very light coat of vaseline. Use it very sparingly, merely wiping the drum with a greasy cloth or waste.

(2) Remove the cover from the automatic switch. Have someone operate it in the usual manner and see that the main contacts are closing properly and also whether the auxiliary contacts close first. If auxiliary contacts are badly worn they should be replaced.

(3) See that the axle bolts are tight and that the universal joints and other moving parts are well lubricated. The driving worm should preferably be lubricated with castor oil or worm-gear oil and the level of the oil should be inspected at least once a month. The old oil should be drained off and replaced at least every six months. Adjust brakes, and if brake linings are filled with grease or dirt, take off the brake shoes and wash thoroughly with gasoline. If the linings are worn out they should be replaced with new ones.

(4) Remove the dust cover from the motor and inspect the commutator and brushes. See that the brush shoulders are in the proper position and tight. At least 60 per cent of the cross-sectional area of the brush should bear on the commutator. The brushes may be accurately fitted by placing a piece of sandpaper between them and the commutator (with back to latter) and grind down the brush to the commutator curve. If the commutator needs cleaning, use fine sandpaper. Never use emery cloth on commutators or brushes. After sanding, make sure that the commutator and the slots between the commutator bars are free from grit.

(5) The wheel bearings should be inspected at least once a month and provided with grease.

(6) Turn up grease cups on wheel spindles and make sure that they are thoroughly lubricated. If wear is evident put in new bushings or make proper adjustment.

(7) Inspect the interlocking mechanism, steering connections and brake connections. See that all joints

Keep Batteries in Good Shape While Operating

In operating the battery, there are certain precautions which are important:

[1]

ALWAYS be sure that there is sufficient water in all cells. The electrolyte should be ½ in. above the plates of lead batteries and of nickel-iron batteries of regular type. In the "high" type of nickel-iron cells, the electrolyte should be 3" above the plates.

[2]

NEVER put additional electrolyte in any cell to replace the evaporation. Use pure distilled water. Additional electrolyte should be used only to replace spillage. In replacing spilled electrolyte in a lead cell give it a full charge and then add sufficient electrolyte to bring the gravity up to 1.280. Add standard solution if a nickel-iron cell till the proper height is reached.

[3]

ALWAYS keep the top of the battery cleaned off. It should be brushed off and then washed clean with water.

[4]

USE vaseline to prevent corrosion around the tops of the cells.

[5]

NEVER allow a battery to stand in a discharged condition. If a tractor is not going to be used for some time, give the battery a full charge before it is laid up. If lead batteries are going to be allowed to stand for several months, they should be given a full charge and then filled with pure water in place of the electrolyte. When it is desired to put these batteries back into service again the pure water may be emptied out and the electrolyte put back in them. Nickel-iron batteries may be allowed to stand with the electrolyte in them.

[6]

DO not allow a battery to freeze. A new nickel-iron battery or a fully charged lead battery will stand temperatures of from 20 to 30 deg. below zero without freezing, but a discharged lead battery or an old Edison battery will freeze at temperatures around 10 below zero. As industrial tractors are rarely submitted to such temperatures as these long enough to cause freezing, this point is not very important.

Charging panel for a fleet of industrial electric tractors.

are greased and that all parts are working.

(8) Inspect the wiring carefully and tape any places where the insulation has been removed or barked. If any wires are in very bad shape they should be replaced with new ones. The best way to do this is to fasten the new wire on the end of the old one and pull it into the proper position by pulling out the old one. Whenever wires are disconnected for any reason they should be properly tagged so that they may be replaced without difficulty. A reversed connection is frequently very difficult to find and sometimes causes a great deal of trouble.

(9) Inspect the battery and be sure that there is sufficient distilled water in each cell to cover the plates.

It is recommended that some particular space be set aside for the inspection, maintenance and care of all tractors in the installation. Very few special tools will be required and any small factory machine shop will contain everything necessary in the way of wrenches, screw drivers, hammers, pinch bar, pliers, soldering iron, drill and bench vise. A reservoir for distilled water with a rubber tube long enough to reach to a tractor should be provided, as well as the special battery-repair tools mentioned earlier in this article. A one-ton chain block should also be provided, and a pit would facilitate work, though it is not necessary.

When following some such plan as outlined for taking care of tractors, the writer's personal experience has shown them to be unusually free from troubles. Of course, there is always a certain amount of maintenance and repair work, which is to be expected on all sorts of machinery, but outside of this there have been no real difficulties. During the days when labor was scarce these machines made it possible to move the same amount of material with a big reduction in the number of laborers needed, and under present conditions they mean a material reduction in handling costs, which is the goal toward which everyone is working.

This Schedule Will Prevent Ordinary Truck Troubles

Every Day

Oil and turn grease cups.
Charge batteries.

Every Week

Inspect controller (inside).
Inspect automatic switch (inside).
Tighten axle bolts.
Lubricate universal joints, driving worm and other moving parts.
Adjust brakes and if necessary remove grease from bands and replace if worn.
Inspect motor commutator and brushes.
Turn grease cups on wheel spindles and put in new bushings if worn.
Inspect wiring.
Inspect battery.
Give lead-and-acid battery an equalizing charge.

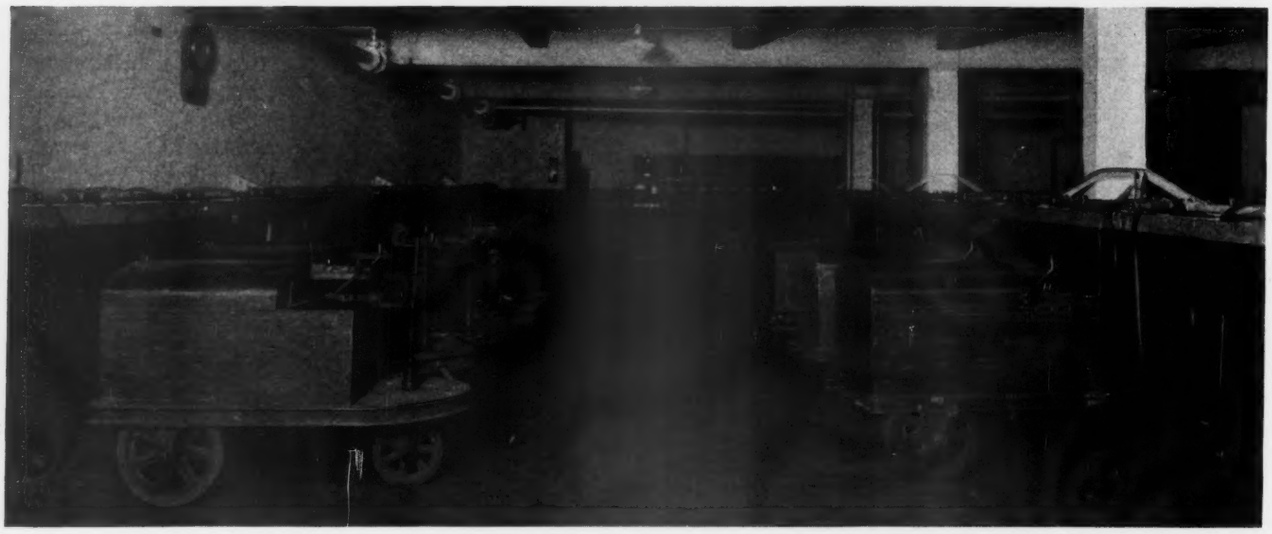
Every Month

Inspect and grease wheel bearings.
Give nickel-iron alkali batteries an overcharge.

Every Six Months

Drain oil from driving worm and refill.

In the illustration below, tractors are shown lined up before charging racks after a day's operation.



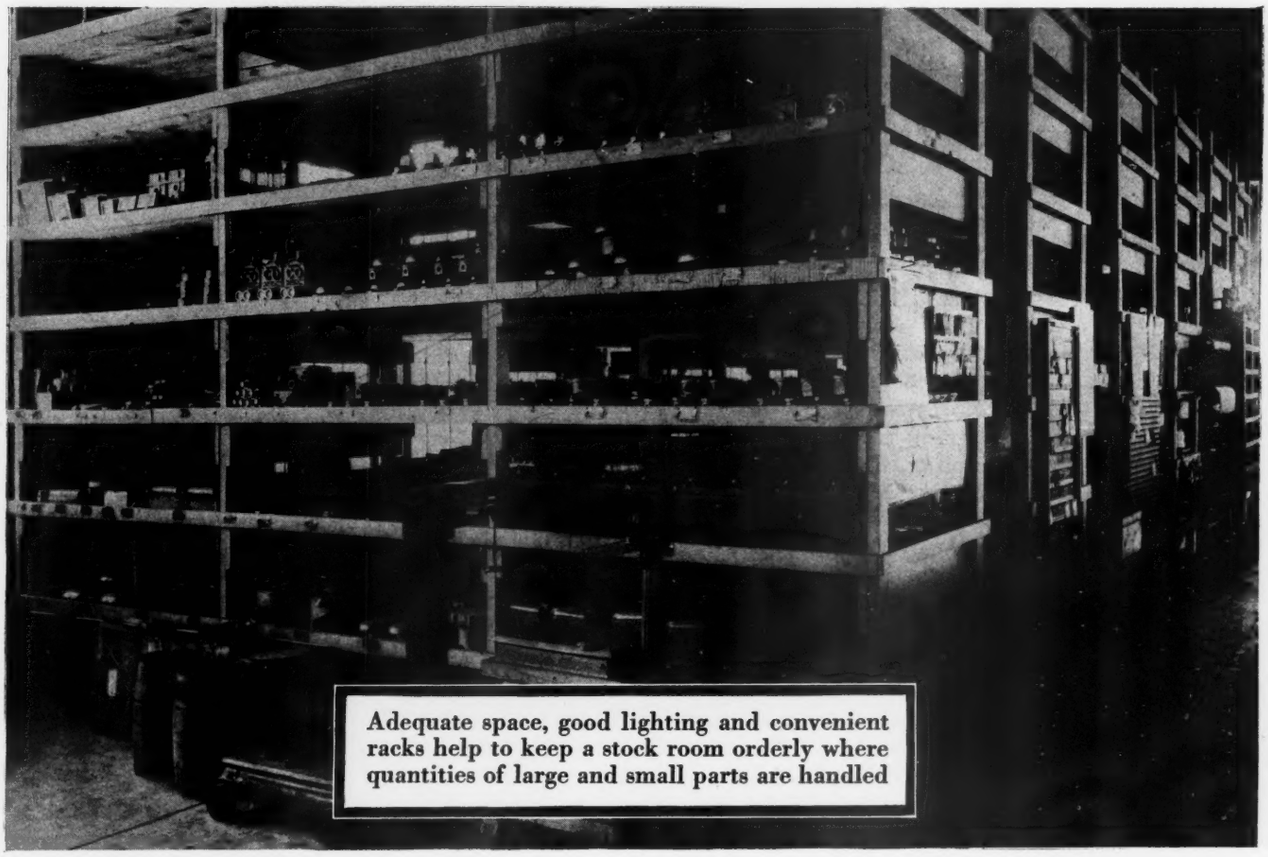
ARTHUR A. BARBERA

explains how

Responsibilities of the Electrical Stockkeeper

are simplified by continuous inventories and up-to-minute records

VERY OFTEN the stockkeeper is looked upon as a man whose duties are exclusively clerical. He is not supposed to have a thinking job, says Mr. Barbera. On the contrary, he should take great pride in his position and feel that he is responsible, as he really is, for smoothly carrying out all construction and maintenance jobs requiring materials from stock.



Adequate space, good lighting and convenient racks help to keep a stock room orderly where quantities of large and small parts are handled

MR. BARBERA has had an extensive experience in a large industrial works in New England, where a revised stockkeeping system reduced the inventory $300,000 by spotting clerical errors.

IN every mill and factory the handling of raw materials, wiring supplies and parts used by the electrical department is an important service function. Under loose supervision the stockroom can accumulate an unwarranted large surplus of material, and not only unduly increase the cost of maintaining the electrical department, but waste space that could be more effectively used and increase the cost of handling material that is needed in routine work.

In large organizations, the electrical material is usually stored separately under the supervision of the electrical engineer, superintendent or electrical foreman in co-operation with the general stockkeeper. Because the general stockkeeper is not always familiar with the various kinds of electrical material, it is important that the electrical man in the plant should have some responsibility in connection with the stockroom. The reason is that the electrical man knows the future requirements of stock better, the spare parts most necessary, and the amount of material necessary for future construction jobs. In the electrical department new equipment is constantly coming in and requires new kinds of stock or parts. For instance, if a new time-clock or fire-alarm system is to be installed in the plant, these systems require different kinds of new material.

The stockroom organization should handle all stock records and render such reports to the accounting department as will permit a perpetual inventory of stock on hand. The stockkeeper should certify to the correct-

ness of his reports and the books of the accounting department should show the value of the stock at all times, after allowance is made for items in accounting suspense. The stock department should list and price the stock with one or more representatives of the accounting department present, and in close enough contact with all parts of the work to certify to the honesty and accuracy of it. Likewise the accounting department records should be checked with a representative of the stock department present. Discrepancies that are found should be corrected by the department originating the entries. From the accounting summaries of the stockroom, an executive should be able to visualize the condition of the stockroom. Thus he may detect careless expenditures and excess material on hand.

Electrical Knowledge Reduced Inventory $300,000 by "Spotting" Errors

To illustrate the advantages and the importance of this arrangement, let me cite a case that occurred in a large plant. It was the first of the year, and the inventory of the electrical stock had just been taken. The amount of money representing the stock on hand totaled nearly half a million dollars, which was a noticeable figure in the eyes of the general manager. It was unbelievable that such an amount of money could be tied up in the electrical stockroom, when a comparison with previous years showed that no such amount had ever been involved. He immediately called the general stockkeeper and the electrical foreman, who were responsible for the stockroom material, to explain why this amount of money was tied up. The electrical foreman went over the list of material with the general stockkeeper and noticed immediately that items such as renewable fuses or fuse links were priced at a dollar apiece, and a good many other items were priced in the same proportion.

Upon investigating, it was found that a careless clerk in the accounting department had set a wrong price on different items, because the inventory had to be in the hands of the chief accountant at a certain date. This order had evidently pressed the clerk for time, and when he didn't have the price of some of the items at hand, he guessed at it rather than take the trouble to inquire. In other cases, he had put the decimal point in the wrong place. After the whole inventory sheet had been gone over thoroughly, it was found to be about $200,000 over. This was a bad case of accounting. It later developed that the clerk was finishing his last week with the company. But it would have been a difficult matter to detect the errors in this case if the electrical man had no jurisdiction over this material, of which he knew the value. The accountants would not have noticed the errors until they had to check the entire list, and the general manager or the general stockkeeper, without knowing the difference in price between such items, could not detect the source of the errors at first sight. It was the electrical man, who knew the difference between a link fuse and a commutator, whose council was essential. Perhaps he did not know the exact difference in the cost of these items, but he did know the relative cost.

To store or not to store must be settled on a scientific basis. Irregularity in the supply of material is not always due to actual shortage or surplus, but to hesitancy to store by some concerns, and a tendency to excessive storage by others.

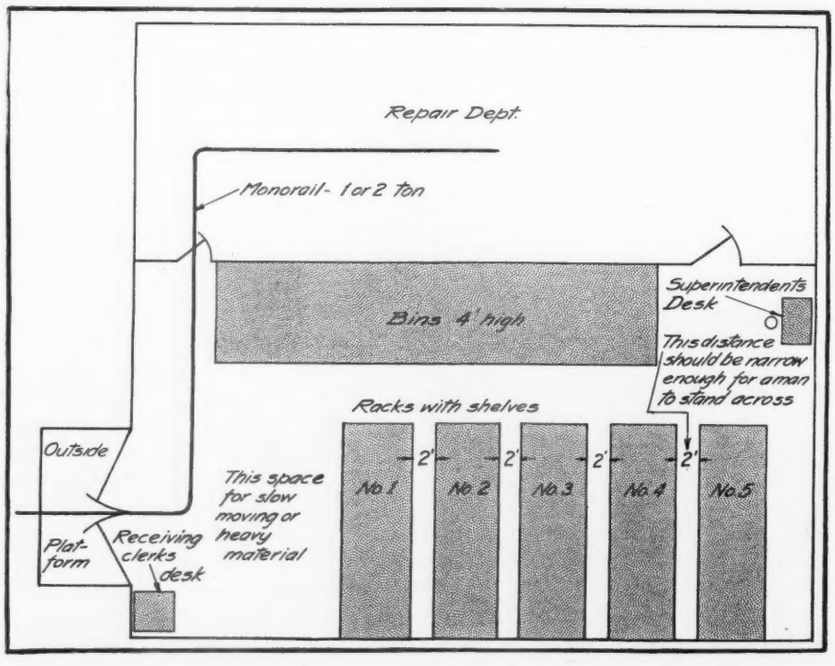
Every work needs a certain amount of material on hand at all times. Every dollars worth of goods carried in stock beyond the sufficiency point creates an expense beyond the needs of production, and to that extent decreases the profits. Insufficiency endangers the smooth working and affects production, thereby entailing severe losses.

Give the Stockkeeper More Recognition

Very often the stockkeeper is looked upon as a man whose duties are exclusively clerical. He is not supposed to have a thinking job. The position of stockkeeper needs better recognition. He is in complete control of a very large proportion of the wealth of many concerns, or if not, it is because of lack of ability and vision on his part, or because he is not given a standing commensurate with that to which he is entitled. The stockkeeper should take great pride in his position, and feel that he is responsible, as he really is, for smoothly working out all construction and maintenance jobs requiring material from stock. It is for him to anticipate needs.

Leave Market Conditions to the Purchasing Agent

The stockkeeper should consider and carefully weigh his storage costs in relation to his maximum and minimum quantities. To commence pondering whether certain price fluctuations justify his increasing or decreasing his stock is dangerous because it may bias his judgment on



A convenient arrangement of stock bins and racks for a stock room adjoining an electrical repair shop.

purely stockkeeping problems. It is better to let the purchasing agent deal with questions of price fluctuations and market conditions.

Materials need space and storage capacity. They must be guarded, protected and controlled. Records of quantities and values must be kept. Before placing any article in a stockroom, space must be provided for it and space costs money. Foresightedness, good judgment and proper calculations of all features outlined are essential to successful storing. It is imperative that all obsolete material be quickly disposed of. It is better, however, never to let obsolete material accumulate. If an infallible system could be devised for fixing maximum and minimum limits it would obviate any danger of having in stock surplus or obsolete material, but this is an impossibility. The only practical solution is constant attention and checks of the maximum and minimum limits set for governing the quantity of each item in the storeroom. If storage space is vacant, there are overhead expenses being incurred such as rent, building insurance, etc. On the other hand, if storage space is fully occupied, there are additional overhead expenses, such as insurance on goods, protection against loss by theft, depreciation and loss of interest on the money invested. Storage conditions are frequently controlled by conditions in the buying market. Conversely, questions regarding purchasing are frequently determined by storage conditions. Only with well regulated physical facts available can the judgment of the buying executive be applied most economically from a production standpoint.

Avoid Congestion in Stockroom Layout

The capital outlay on a storeroom includes a varied investment in equipment. Both fixed and movable equipment are necessary, and consist of racks, bins, apparatus for weighing, measuring, moving, handling, etc. Although no two warehouses or storerooms may be similar in size, location or equipment, still there are well defined rules for determining the overhead charges comprised in the capital outlay and studies of the controlling conditions of different plants are essential to greatest economy.

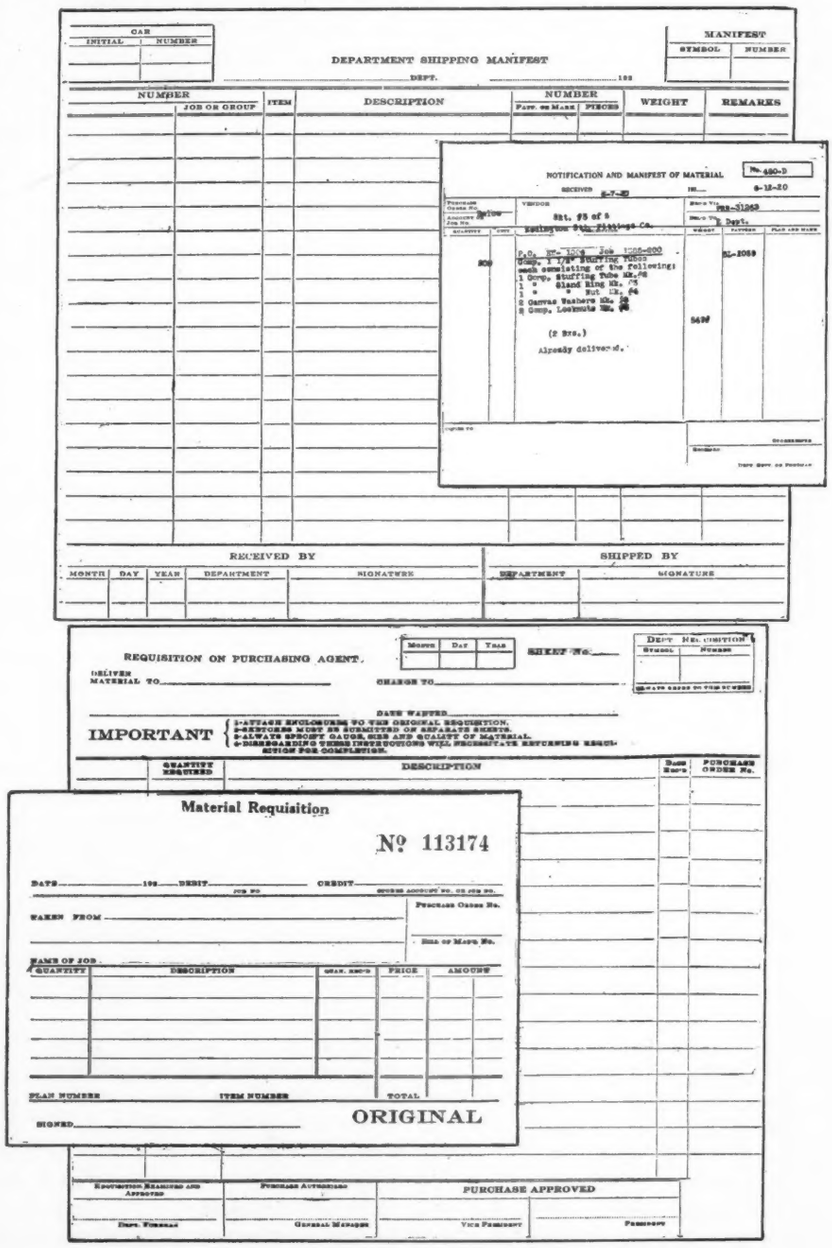
Location has an important bearing on this question of storing and it assumes some magnitude, if the storeroom is in an expensive section of a city or in a congested district. Such a condition might prohibit the use of large areas, or it might render necessary the location of the stockroom in some less expensive section. Other factors affect the question of space. If it is curtailed to a point of congestion in the stockroom, many inconveniences and delays will occur in handling materials two or three times, when only once would be required if space were ample. The lack of space and additional handling may also cause physical damage to the stock. Only one result is possible from insufficient storage facilities, and that is extra expense and added costs.

Forms that are simple and easy to fill out reduce many of the complications in checking stock.

The four forms shown have been found adequate in a large works handling a wide variety of large and small parts. The manifest of material is checked at the receiving platform and again upon receipt at the stock room, where a card record is made out. Requisitions are filled out in triplicate, the original going to the accounting department, the second copy to the main stockroom and the third copy held by the stockkeeper filling the order. The department shipping manifest is used when material is transferred from one department to another. It is made out in triplicate, one copy for the sending and receiving stockkeepers and the third for the main stockroom.

Practical Stockroom Suggestions

The stockroom should, wherever possible, be on the first or ground floor, so as to avoid the use of ele-



vators and stairs when the stock is being stored. In laying out the stockroom, there are three things that ought to be considered. First of all is accessibility, such as passage-ways, location of racks, etc. Second, location of slow-moving stock, such as armatures, motors, transformers and reels of cable. In the case of lead-covered cables, these are sometimes left outside. Third, location of quick-moving material, such as fuses, porcelain cleats, nails, screws, spare parts, etc. The layout should insure that the quick-moving material is easily accessible. Racks and shelves should be so planned that a man can reach and stand across the passage-way on these shelves, thereby using the shelves as steps in place of a step-ladder. He can in this way conveniently reach the top shelves or those at any height. A step-ladder other than a permanent one on sliding rails is a very poor fixture in a stockroom and is always in the way. The shelves should have a strip of molding on the outside edge to serve as a hand grip both in climbing up and in taking off material. This molding also serves to keep the material in place, and this applies to steel as well as to wood.

Many stockrooms adjoin the electrical department headquarters and repair shop. When this is the case, assuming that the receiving platform is in the rear of the stockroom, it is a good plan to have a monorail hung to the ceiling, with a one or two-ton chain fall, running from the outside over the platform to the rear of the stockroom and continued into the repair department. This will enable motors, armatures, etc., that are to be repaired to be easily handled.

Accurate Stock Descriptions Important

For every article there is a correct description. This may consist of only two or three words and figures, but it is essential that the shop designation should be used and a list furnished to heads of departments that use the stockroom. All material should then be properly identified so that no misconception can possibly exist as to what is actually meant. Failure properly to describe articles or to have standard methods of defining them leads to endless confusion in stockrooms and entails much extra work and expense in referring requisitions back and forth. On the other hand, when a stockkeeper draws up a requisition for materials or supplies and uses incorrect or inadequate description, it is more than probable that these will be repeated by the purchasing agent in sending out his inquiries and orders. The recipients of these will "come back" with requests for information of a more exact and definite nature.

The specification of the material along with the quantities, etc., should be kept on cards properly indexed and so arranged that they can be found quickly either by number or title. In many cases, particularly with spare parts where the specification is lengthy, a general description is given and the bins are numbered. The bin number then follows the description of the article when it is requisitioned. For example, in the case of a brush holder, the description would read: Brush holder, size, name of manufacturer, bin number, etc.

Simple Records Are Effective

The system of keeping in touch with the material as it is dispersed daily should be simple and easy to keep. Such records can be kept on a card-index with deductions and additions made daily. Such a record will always indicate the amount on hand. This method serves to indicate also when material is running low, and the stockkeeper can order promptly from these cards.

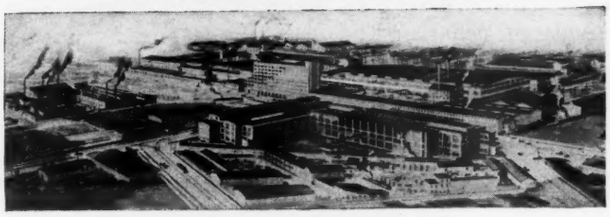
In ordering material for the stockroom the most satisfactory system is for the stockkeeper to make out a requisition on the purchasing agent for the material, this requisition being approved for purchase by the authorized department heads. In the case of special material, the department head should order the stockkeeper to make out a special form, giving a description of the special material required. This form should be made out in triplicate. The original, with all the approved signatures, should go to the purchasing agent, the duplicate to the main stockroom, and the triplicate to the department issuing it.

In a large industrial plant the usual practice is to receive material at the main stockroom. Material is gone over and checked at the receiving platform, and a manifest is made out, with one copy to each department interested. The manifest or notification of material received should show the vendor's name, quantity and description of the material. When the electrical department stockkeeper, in this case, receives the material it should be again gone over and checked and an entry of the material received made on his card-index system. If the material is found to be unsatisfactory in any way, the proper notation should be made on the Stock Received entry and the purchasing agent notified at once. Material should be withdrawn only by requisitions made out by foremen authorized to sign them. The stockkeeper should have a list of these signatures. The requisitions for material should be made out in triplicate, the original copy for the accounting department, where it is priced; the duplicate for the main stockroom and the triplicate for the stockkeeper requisitioning the material. Applicants for material should never be permitted within the stockroom. The practice of allowing them to select from the stock what they need is entirely too common. Many stockkeepers compromise by permitting applicants to go to the shelves and get what they need, checking the weight or count as the applicant passes out of the stockroom. Such methods as this should not be tolerated. If a loose system prevails, either in receiving or delivering material, the stockroom records cannot be considered reliable. Before the material leaves the stockroom the stockkeeper should insert the quantity delivered on the requisition.

There are occasions in some industrial plants where material is transferred from one department to another. In this case, a department shipping manifest should be made out in triplicate with the signatures of the sending and receiving stockkeepers, each receiving a copy which is made out by the sending stockkeeper, the third copy going to the main stockroom. It can be easily seen that if the electrical stockroom is a branch, the third copy is useful, whereas, if it is part of the main stockroom, the third copy can be eliminated. It is a good idea to have the different copies of forms made in different colors so as to distinguish copies that are to be forwarded to the departments concerned.

The procedure which the writer has outlined is one that is used today in the electrical departments of several large industrial plants.

ELECTRICAL REVIEW
AND
INDUSTRIAL ENGINEER



DANIEL H. BRAYMER
Editorial Director

Assisted by
G. A. VAN BRUNT E. H. HUBERT C H. REEDER

Chicago, January, 1922

Why Engineers Are Misunderstood

ENGINEERS are frequently accused of being unable to clearly express themselves to non-technical people. Why this should be so is sometimes hard to understand, yet there is sufficient evidence at times to justify in part this accusation. The difficulty seems to lie in the tendency of the engineer to discuss the subjects in which he is interested as one specialist talking to another instead of reducing the subject to the language that his wife or his mother might comprehend.

In the main the average run of engineering problems is not shrouded in mystery, and the engineer is an ordinary type of person who lives in a house and wears the same sort of clothes as most people, so that a little introspection and a study of human nature could overcome the handicap of the top-lofty attitude he is sometimes unjustly supposed to possess. Since the engineer who supervises the work of others in an industrial works is in contact for the most part with non-technical men, his ability to make himself perfectly understood in non-technical language is one of his greatest assets.

Electrification of Industrial Works

FROM the set of charts elsewhere in this issue showing the present state of electrification of American industries some interesting deductions can be drawn. For instance, railroad repair shops are the most highly electrified of all works. Plants manufacturing vehicles of all kinds stand next in order. About one-half of the iron and steel industry is electrified, but only a little over one-quarter of the lumber industry secures its primary power from electrical energy. This low electrification of the lumber industry is, of course, due to the isolation of a large proportion of the lumber mills, making it difficult to secure energy from the distribution systems of the electric light and power companies of the country.

The iron and steel industry leads in horsepower of installed electric motors. Ratings of motors, however, cannot be taken as a criterion of the use of electrical energy by the iron and steel industry, for a large proportion of the electrical energy consumed by the iron and steel mills is for electric furnaces and industrial heating. In Pennsylvania, for instance, there are only 91,700 motors installed with a total rating of 1,061,000 hp., but this industry in Pennsylvania alone consumed 2,515,000,000 kw.-hr. in 1919. The textile industry in all its various phases stands second in amount of installed motor horsepower. This is worthy of note because the textile industry uses a large number of motors of comparatively small horsepower rating.

The indications are that large strides will be made in the electrification of American industrial plants during the coming five years. While it is always unwise to attempt the role of the prophet, information is in hand which indicates that new installations and replacements in industrial works will call for electrical equipment and supplies during the next three months valued in the neighborhood of $150,000,000 based upon present prices.

Service From Electric Motors

THERE is one point, at least, in which the interests of the motor manufacturer and the user of electric motors are identical, namely, service. It is the aim of the designing engineer to produce apparatus which will give the best possible service, and it is the aim of the works engineer to select and install both motor and control devices from the same viewpoint. The latter's efforts are concentrated on the one point—uninterrupted service—combined, so far as practicable, with minimum operating cost and maintenance expense; but freedom from shut-downs is the essential point. A single breakdown of motor or controller may tie up an entire manufacturing process in a mill and cause incalculable loss in production, or even directly effect the safety of the men employed. The head of the department responsible for the operation of the electrical equipment of a plant is confronted, therefore, with the imperative necessity of eliminating interruptions. The efficiency of his department is measured in inverse ratio to the minutes of delay in operation. His insurance is the use of quality equipment and an adequate inspection system. His return on this investment is service.

Judgment vs. Main Strength

IT IS an impressive sight to watch a well-organized and well-directed group of skilled operators handle a heavy piece of apparatus on a repair job. But such a sight, impressive as it may be, only serves to show what a small and weak unit a man is when measured by his physical effort alone. However, when that effort is used to direct a power-driven machine designed for lifting duty, it is multiplied hundreds of times.

Specific examples of the utility of lifting and carrying machinery may be found in every industry. For instance, it is frequently necessary to replace a damaged motor with a new or repaired one. In such cases the new motor may be in stock at a considerable dis-

tance from the point where it is to be used. The motor could be carried, possibly, by several men if it were a small one, or it could be placed on rollers and moved by hand. It would ultimately get to its destination, but it might require hours if the motor happens to be a large one. In contrast with such a method of handling, the modern method involves the use of traveling cranes and power-operated trucks to lift and carry the new equipment in minutes instead of hours.

Modern material-handling equipment not only reduces the time and cost of handling equipment in repairs but it calls for the exercise of judgment instead of main strength. It's the operator who uses his head in the modern works who is master of the position he holds.

The Position of Metal Superintendent

ALTHOUGH the Heroult electric furnace is often referred to as the pioneer in the production of electric steel, it is a matter of record that Captain E. Stassano, an Italian, began experimenting on the production of steel directly from iron ore in an electric furnace in 1898, about two years before the fundamental principles of the Heroult steel furnace were patented. The start in the evolution of the electric furnace, however, dates back to 1878 and the Siemens direct-current laboratory furnace, consisting of a crucible of refractory material with a movable vertical electrode and an iron bar passing up through the bottom of the crucible as the other electrode.

The production of electric steel as a commercial process, however, is less than 20 years old, for in 1904 there were only four electric furnaces in operation, and these were in European plants. Today there are nearly 400 electric furnaces producing steel in this country and 250 used in the melting of non-ferrous alloys. There has grown up with the installation of these units a new field for skilled operators leading to the position of metal superintendent. This work calls for a practical knowledge of metallurgy, a study of electric furnace designs and their electrical requirements, together with ability to direct furnace operators and melters.

We Are All Custodians

THE name custodian or caretaker usually calls to mind the superintendent of a larger building or estate, or a banker or other person who takes care of something that is large and visible. That is correct, as far as it goes, but in a sense every one of us, no matter how rich or how poor, is the custodian of something. Due to circumstances and perhaps the whims of Fate, we cannot all be bankers or caretakers of estates and buildings, but everyone who comes into this world with anything like a normal mind, is at least the custodian of his mind and body. He must do his own thinking and eating and sleeping. It is entirely up to him to see that both mind and body get the kind of food and attention that will make them develop and grow strong.

Getting down to a specific case, the operating engineer of a mill or factory carries a good deal of responsibility. When a piece of equipment is turned over to him, he at once becomes the custodian of several important things. In the first place the equipment represents an investment, an outlay possibly of many thousands of dollars. The operating engineer must see that this investment is conserved by careful, intelligent handling, that faults or weaknesses are immediately detected, repairs properly executed, and replacements promptly made when necessary.

Not only must this investment be conserved in these ways, but it must be made to pay a satisfactory return in the form of continuous production at the highest possible efficiency. This means besides skilled care, efficient operation and the elimination, as far as possible, of every factor or condition which tends to reduce machine efficiency. In the equipment a large investment of time, money and brains has been made also by the manufacturer and to a certain extent he stakes his reputation on the performance of his product. Again it rests with the operating engineer to say whether this investment shall pay the full return in the way of superior service or whether it shall be discounted through careless handling and slipshod methods of inspection and repair. It rests with him whether the reputation which that manufacturer has striven hard to build up shall be brightened or dimmed in the eyes of those who have purchased his goods.

Custodianship, which after all, is another label for responsibility, is conferred on those who show initiative and reliability in the performance of their duties. And with increased responsibility there inevitably comes increased material reward and that intangible something which we call "position."

Cleanliness in the Matter of Lighting

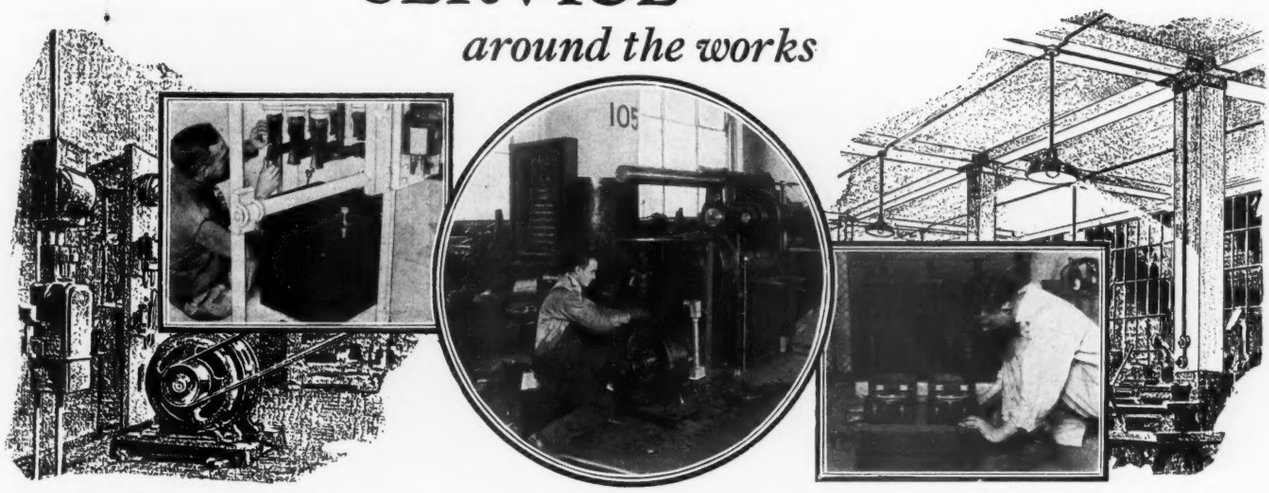
WHEN the question of providing electric light for a factory comes up a queer sort of economy is frequently practiced. If the same plan were followed in ventilation the fresh air supply would be cut down until the workmen just became drowsy from the vitiated atmosphere and then the fresh supply would be increased 10 per cent and let it go at that. Such a plan in the matter of ventilation would be called foolish, but when applied to lighting it is called economy.

Even when sufficient illumination is provided to see well when the system is first installed, the accumulation of dust and dirt on lamps and reflectors in the average works is sufficient to consume a liberal margin of illumination over that considered adequate.

Light is one of the cheapest tools that can be furnished a workman and intensities far beyond those required to see well have been found good economy. No two installations can be compared except on the basis of the operations performed, and then a little experimenting in the intensity will always be worth while. Moreover, a systematic program of washing reflectors will be as productive of good results as cleaning the floors. When it is considered that it only costs something like three cents apiece to wash reflectors to save approximately half the light that might otherwise be wasted the virtue of cleanliness becomes apparent.

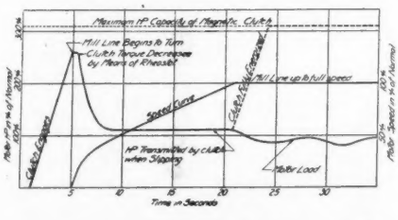
SERVICE

around the works



Magnetic Clutch Connects Main Flour Mill Drive to Motor

RECENTLY some tests were conducted in a flour mill in Minnesota to determine the starting characteristics of the main drive, which consisted of a 500-hp., 225-r.p.m. synchronous motor, connected to the main line shaft of the mill through a Cutler-Hammer 60-in. magnetic clutch. When the mill had been shut down over the week end it required two to three times the normal horsepower to start the mill line. The



Operating curves for magnetic clutch on synchronous motors.

usual type of synchronous motor cannot exert this amount of torque in starting, but by combining it with a magnetic clutch the acceleration of this type of load is accomplished without difficulty.

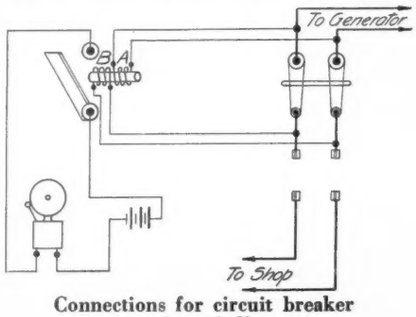
With a load requiring 125 per cent of 150 per cent of full motor torque the clutch could be energized and the load connected simply by closing a knife switch or operating a push button station. With such a heavy initial torque as is required by the flour mill load, however, it has been found more satisfactory to add a small rheostat to control the clutch torque. At the Commander mill, where the tests were made, the most satisfactory method of operation was as follows: When the motor has attained synchronous speed the clutch is energized and the rheostat handle moved quickly to a point which allows the clutch to develop a torque corresponding to approximately 250 per cent of full load motor current. During this time an ammeter which shows the current going through the motor is watched by the operator. Then, as soon as the mill begins to turn, the rheostat is adjusted to reduce the clutch torque until the motor is taking about normal current. This allows the clutch to slip for about fifteen or twenty seconds, the time necessary for the mill line to come up to full speed. The rheostat is then thrown to the "full on" position.

Another interesting point noticed in installations of magnetic clutches on flour mill drives is the change in the time necessary for acceleration. Two years ago the concensus of opinion among flour mill operators seemed to be that a starting period of less than thirty seconds would be impossible. After synchronous motors and magnetic clutches were installed it was disclosed that acceleration from standstill to full speed was possible in ten seconds, and that in this period no belt slippage or abnormal condition prevailed in any part of the mill. The maximum time reported for the synchronous motor magnetic clutch drive has been 25 seconds, and the general recognized average time of starting for this drive is between 15 and 20 seconds.

Milwaukee, Wis. F. R. LUFKIN.

This Circuit Breaker Alarm Attachment Tells When Circuit Is Opened

THE circuit-breaker on the engine-room switchboard of a factory power plant frequently tripped while the engineer was out in the boiler-room. When this happened, valuable minutes were lost by the shop before the engineer was apprised of the fact that the breaker was open. The installation of an alarm bell to signal the engineer when the circuit-breaker tripped



Connections for circuit breaker alarm bell.

was finally ordered. Because of local conditions it was not deemed advisable to remove the circuit-breaker and drill the switchboard for the installation of the standard type of bell-ringing attachment. In addition, it was desired that the bell-ringing circuit would be put in service every morning without the need for the engineer to close the special switch, which would be necessary with the standard attachment. This condition resulted from the practice of tripping the circuit-breaker every evening prior to shutting down the engine. To satisfy these requirements and accomplish

the desired results the arrangement shown in the accompanying diagram was adopted.

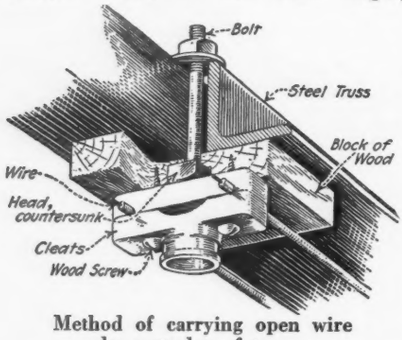
An ordinary controlled contactor, normally open, was provided with two high-resistance coils and mounted on a treated-wood base on the wall near the switchboard. Connections to the main power circuit and to the bell were made as shown, care being taken to connect the coils *A* and *B* so that they neutralize each other when both are energized. When the plant is in operation and the circuit-breaker closed the contactor remains open, due to this "bucking" effect of the coils. When the circuit-breaker trips, however, coil *B* no longer opposes coil *A* and the contactor closes under the action of coil *A*, thus completing the bell circuit and giving the alarm. The bell circuit remains closed until coil *B* is again energized by closing the circuit-breaker. The contactor coils each consume 15 watts, so that the cost of operation is negligible for the reliability of service obtained.

J. M. WALSH.

Honesdale, Pa.

Method of Supporting Conductors on Steel Members

FOR carrying open-wire circuits along the roof trusses and other members in modern steel-frame industrial plant buildings an economical and satisfactory type of construction is shown in the accompanying drawing. It consists of clamping a wooden block to the steel angle,



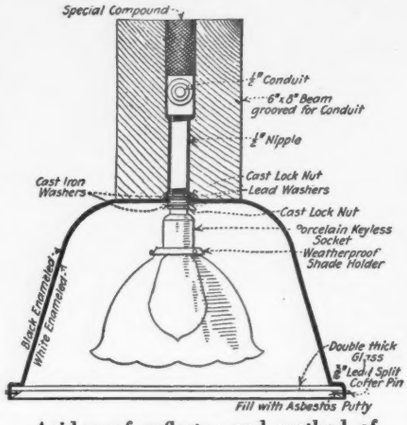
Method of carrying open wire along steel roof trusses

struts, ties or chords by means of a through-bolt. Each block is bored for the bolt and is in addition countersunk so that the head of the bolt will lie below the surface of the block. To this block the porcelain cleats can be fastened with wood screws. Small receptacles or other wiring fittings can be mounted on these wooden blocks.

Detroit, Mich. C. WALKER.

Acid-Proof Construction for Conduit and Lamps

FOR protecting conduit runs and lamps against acid fumes in the plants of du Pont de Nemours & Company the construction shown in the accompanying drawings has proved very efficacious. The conduit is protected by running it in a groove cut in the 6-in. x 8-in. wooden beam. After the conduit is laid this 4.2-in. groove is filled with a special



Acid-proof reflector and method of protecting conduit used in acid plants

compound called rubrax. The whole of the exposed surface of the beam is then given a coating of the rubrax. The lamps are inclosed in a heavily enameled reflector, which is closed at the bottom by a double-thick clear glass. This glass is held in the reflector by means of lead split cotter pins. The cracks between the glass and the rim of the reflector are closed by a fillet of asbestos putty. A weatherproof shade holder and a porcelain keyless socket are employed. For fastening the reflector on to the nipple leading from the conduit cast-iron lock-nuts and washers, in conjunction with lead washers, are used.

W. B. TODD.

E. I. du Pont de Nemours & Company, Wilmington, Del.

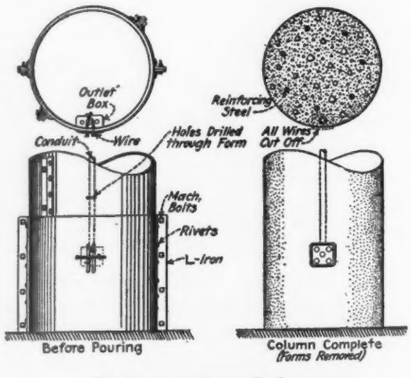
Caution in the Handling of Enameled Lamps

IN THE the December, 1921, issue of the Edison Sales Builder, published by the Edison Lamp Works of the General Electrical Company, O. P. Anderson points out that at the present time lamps which are enameled or sprayed are either wrapped in wax paper or in tissue paper to prevent scratching or chafing of the enameling. It is recommended that when these lamps are handled they be kept in the paper in order to keep them from being soiled. In the case of bowl enameling on Mazda C lamps it is essential that the enameling be baked by burning the lamps before the enamel is washed, since it is possible to wash it off before the enamel has been baked in this way. In the case of Mazda B lamps, which have been sprayed a bloom or white powder, will sometimes appear on the bulbs. This does not indicate that anything is wrong. The bloom can easily be removed by washing the bulb.

N. W.

Setting Outlet Boxes in Concrete Columns

ONE of the common methods of supporting conduit outlet boxes in the steel forms for concrete columns is to set the outlet boxes in the required locations against the side of the form after the steel forms have been erected but before the reinforcing steel has been placed in them. Then the box and the conduit are wired to the form in such a manner that neither can be displaced by the concrete when it is being poured. It is necessary to drill small holes through the metal forms with a small-diameter drill to permit the tie wire being placed. A hole that is ⅛-in. in diameter is ample. Each outlet box should be stuffed full of paper before it is placed in the form, to prevent the entrance of the con-



Outlet on column before and after concrete is poured

crete. After the forms have been removed, the tie wires which extend from the concrete column should be snipped off close to the surface of the column. Care should be exercised to insure that the conduits to the boxes are fastened firmly in the form, so that there can be no shifting while the concrete is being poured.

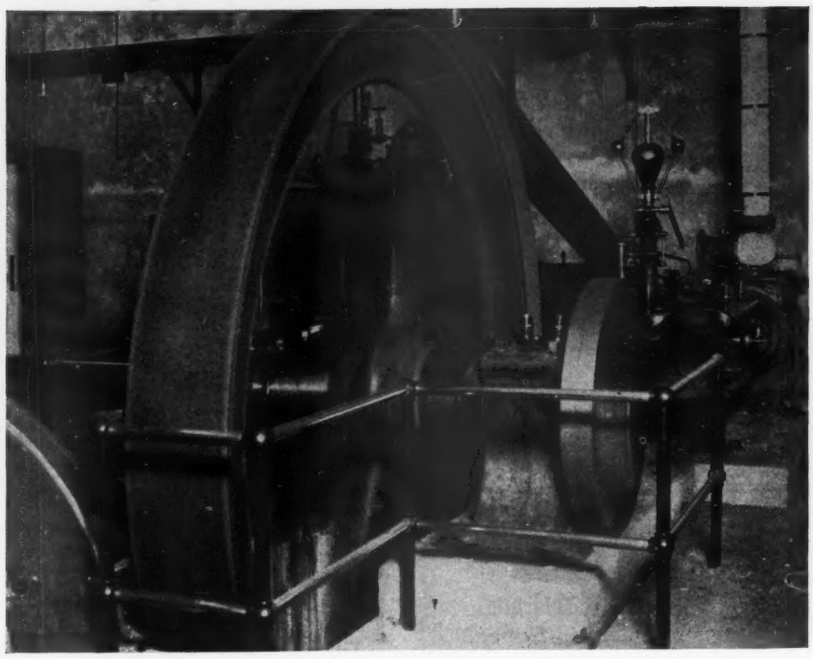
Dallas, Tex. T. F. DICKMAN.

How An Ice Machine Was Converted to Electric Drive at Small Cost

STEAM driven ice machines were converted to electric drive at a small cost on the lines of the Portland (Ore.) Railway Light & Power Company, by bolting a steel band to the fly wheel to get the necessary belt surface and applying a motor of the proper size. The accompanying illustration shows an ice machine driven by a 50-hp. motor which was changed over in this manner. A sheet steel band, 1/4-in. x 10-in., made in two pieces, was fitted to the 6-in. face of the flywheel and secured by machine bolts countersunk in the band, spaced two feet apart and staggered around the wheel. The cost of installing this steel band was only $20. The radius of the fly wheel is generally taken and these bands made to the proper curvature before being taken to the job. The picture is a view from the steam side of the machine, and shows where the crank has been removed and clearly shows the steel band projecting two inches beyond the edge of the cast iron fly wheel. In the background may be seen the motor, as well as an idler pulley which guides the belt into the wheel pit.

W. C. HESTON.

Industrial Power Engineer.
Portland, Ore.

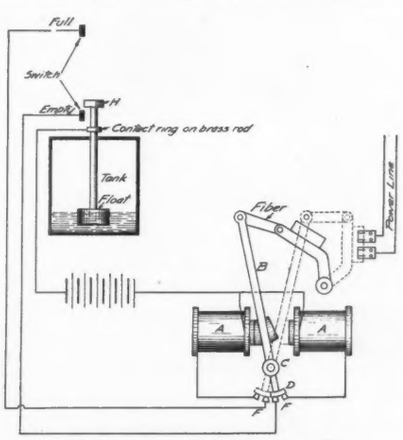


A steel band on flywheel provides belt surface for ice machine.

Electrical Control for Water Level Built from Scrap Material

IN order to provide flexible control for an electrically-driven triplex Goulds pump supplying water to a 3000-gallon tank, the writer constructed the equipment shown in the sketch out of material obtained from the scrap pile. The motor which operated the pump was originally equipped with an electric regulator; but owing to the shallowness of the tank, there was not enough difference in the pressure between high and low water to regulate the pump. It could be adjusted to stop the pump at high water or start it at low water, but not both.

The sketch shows that (*A-A*) are magnets arranged on a slate with a steel lever (*B*) hinged near the bottom end (*C*) and acting as the armature for the magnets. At the bottom end of the lever a copper segment (*D*) was secured, but insulated from it, which acts as a switch, closing the circuit between each pair of terminal blocks (*F*) as the lever changed positions. The top end of lever was connected to a knife-switch by a fiber connecting rod. On the tank a standard was arranged carrying a switch at top and bottom. A 1/2 in. brass rod carrying a float and passing through an insulated guide in the cover of the tank makes a sliding contact through a brass terminal ring (*H*). Then a lug fastened to this rod makes contact with the top or bottom switches, depending on whether the tank is full or empty, thereby closing the circuit on the 10-volt battery through the opposite magnet. This would throw the power switch and also put switch (*D*) in position to operate the next time. Outside of cleaning the contacts occasionally we have never had any trouble with it.

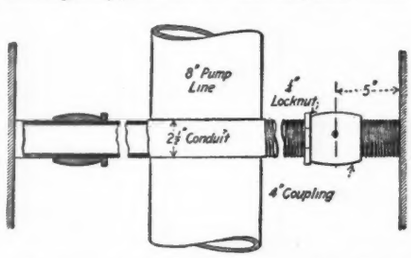


Magnets control main switch according to position of float contacts.

Camden, Maine. M. M. BROWN.

Emergency Arangement for Uncoupling Conduit

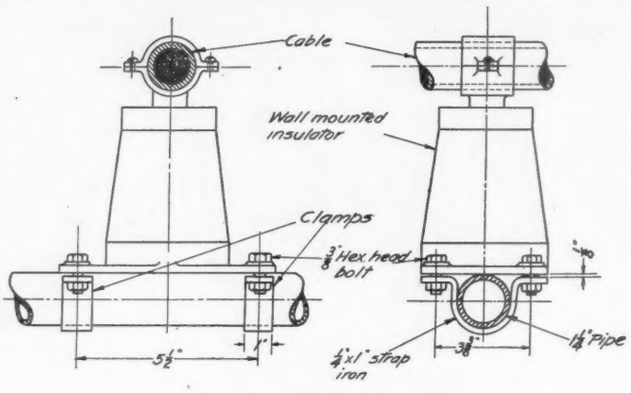
IN ONE industrial plant where a motor feeder crosses a pipe line at right angles some method had to be employed to allow easy and quick removal of the conduit in case of an emergency, since it was rigidly held at both ends. To do this the conduit was sawed off so that about 5 in. extended into each side of the trough in which the pipe was laid. The ends were threaded so that a 4-in. coupling would fit tight when screwed on for one-half of its length. The section of conduit sawed out was also threaded on both ends so that a 0.25-in. lock nut and the coupling would screw on easily. By jamming the lock nuts against the couplings the conduit is made rigid.



Section of conduit crossing pipe line can be removed by loosening lock nut and unscrewing coupling.

IRVING E. SWEAZEY.

Plainfield, N. J.



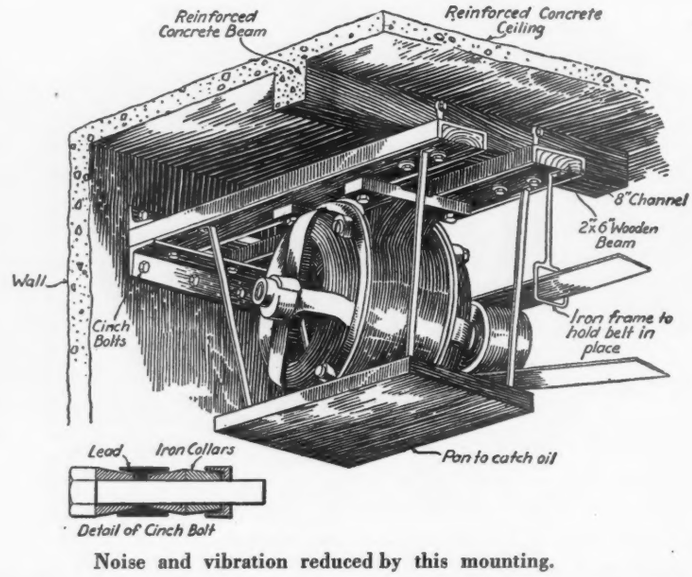
Iron strap used to fasten wall insulator base to pipe.

Service Is Sectionized at Stairway Landings

AT THE Hendee Manufacturing Company's plant in Springfield, Mass., the power service of various departments and floors is conveniently sectionalized by automatic oil circuit breakers installed in the stairway landings. A main cut-out box is also provided beside the breaker so that the control of power service is centralized. A group of departments can be isolated from the rest electrically and on account of the location of the circuit breakers can be restored to service with minimum loss of time. When repairs are necessary such an arrangement is of great convenience because it enables production to be resumed within a few seconds of the time when all is in readiness for the floor output.

Necessity for Reading Watt-Hour Meter Daily

THE necessity for reading the watt-hour meter daily was brought forcibly to the attention of an industrial plant in the Middle West recently when the energy bill for one month greatly exceed previous ones. An investigation showed that a 150-kw., 440/660-volt, three-phase, 60-cycle motor-generator set had been operating as a single-phase machine. The motor of this set is of squirrel-cage type, and it is started by means of a standard compensator, there also being an oil switch and an ammeter in the incoming circuit. The ammeter has a total scale of zero to 800 amp. A watt-hour meter registers the energy used and is a basis of the monthly bill by the electric service company.



Noise and vibration reduced by this mounting.

Wall-Mounted Insulator Base Readily Converted Into Pipe-Mounted Type

RECENTLY a New York electrical company used a regular wall-mounted insulator base as a pipe-mounted insulator. Since there was insufficient time to order the regular pipe-type insulator, clamps made of 1/4 in. by 1 in. strap iron, bent into shape as shown in the illustration and fastened to the wall insulator, allowed the job to be finished on time. FRANK HARAZIM.

New York.

Testing Contact of Knife-Switch Blades

IN ORDER to be assured that the blades of switches make good contact with the jaws, a "feeler" is sometimes used. This device can consist of any thin, hard material, but usually a piece of mica, about 3/8 in. wide and a couple of inches long, is satisfactory. A very thin piece of sheet steel will also serve. The feeler should be about 0.003 in. thick.

To use the tool, insert it between the jaws and the blades at different points. At locations where it can be pushed in readily the contact is poor. Such difficulties may be corrected by light hammer blows on the jaws. The blade should always be "ground in" to insure good contact between it and the break jaws.

Denver, Col. H. J. WADE.

Motors Mounted on Wood and Iron Beams

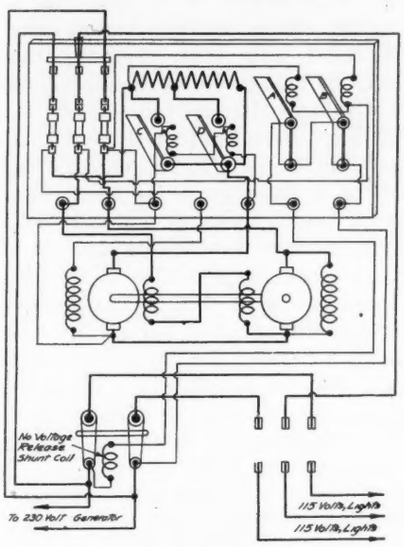
BOTH installation and replacement are facilitated by means of the motor support shown. It consists of channel-iron pieces attached to angle irons on the wall at one end and held by bolts through concrete beams at the other end. In the channels are 2-in. by 6-in wooden beams so arranged that the motor can be placed in any position along their length.

The wooden beams in the channels also serve to cushion vibrations and thus reduce noise. The angle-irons are fastened to the wall by "cinch" bolts.

To prevent the belt slipping from the pulley, a guide is attached to the beam as shown. Dripping oil is collected in the pan supported below the motor.

Lamp Burnouts by High Voltage Prevented by Balance Control Set

LAMP burn-outs were frequent on the 115-volt lighting circuits of a factory power plant, due to high voltage resulting from unbalancing of the three-wire system. The three-wire service is derived from a two-wire 230-volt power line from the factory plant through a 6.5 kw., 250-volt compound balancer set. The lighting circuits were protected by a two-pole overload type of circuit-breaker mounted on the main shop switch-board. This, however, gave no protection against the high voltage referred to above, being equipped only with a no-voltage release shunt-trip coil. The trouble was successfully overcome, without changing the main circuit-breakers, by the use of the accompanying scheme of connections.



D. C. balancer set control diagram.

The balancer control-panel is separate from the main shop switch-board which carries the lighting circuit switches and circuit-breaker. The contactors *A* and *B* are connected in the circuit of the no-voltage trip coil on the circuit-breaker. The coils of the contactors are connected one across each 115-volt circuit so as to open the contactors when the voltage on the lighting circuits goes above 120 volts. As long as the voltage across either 115-volt circuit remains at or below 120 volts the two contactors remain closed, maintaining the connection of the no-voltage coil across the circuit-breaker terminals. This is effected by properly adjusting the air-gap of the contactor armatures. When the voltage on either side rises to more than 120 volts the contactor on that side opens, thereby breaking the no-voltage release shunt-coil circuit and opening the breaker. This action, however, does not stop the balancer set, since the latter is connected in ahead of the circuit-breaker. Thus, the necessity for re-starting the balancer is avoided, but the circuit-breaker cannot be closed so long as the high-voltage condition remains.

It will be noted that the starting of the set is effected by simply closing the knife switch on the balancer control panel, the armature contactors *C* and *D* automatically cutting out the armature starting resistance. The set is started prior to closing the circuit-breaker.

Honesdale, Pa. J. M. WALSH.

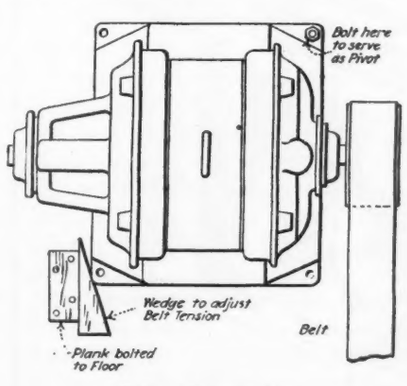
Motor Installation for Temporary Drive Not Bolted to Floor

WHEN a motor driving a machine tool or the operation of a Shepard crane over a foundry furnace it was found that the iron shoes and the iron rails would get more or less rusty from the steam given off by the molding sand when the castings were being cooled off after each heat. This would cause trouble, since the crane shoes would fail to make contact at once and spit sparks. This trouble of poor tension at the contacts was overcome by riveting (as shown in *A*) to the upper surface of the iron shoes a strip of copper five inches long, two inches wide and one-eighth inch thick. After the three shoes of the three-phase system were thus equipped the sparking was greatly reduced and the copper partially overcame the rust.

This same crane was often left by thoughtless persons standing idle with the 440-volt main switch closed, which was risky for the oiler and electrician doing repairs. Four red pilot lights were connected, as in *B*, through small fuses at the main switch, each pair glowing in parallel when the current was left on. Four lamps were used in case the filament burned out on any one lamp, so that a true warning would still be given.

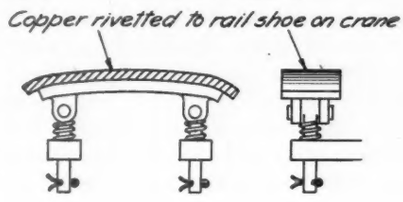
Little River, Conn. H. S. RICH.

be installed for use over a short period of time, the method shown here has been used with good results. The adjustment of the motor in relation to the driven machine is very simple and can be accomplished in a short time. Only one corner of the motor base is bolted to the floor. This in itself saves considerable time in making the installation. Diagonally opposite the bolted corner, a plank is attached firmly to the floor. The wedge is then inserted between the plank and the motor base as shown, so that the motor position can be adjusted until the belt travels on the center of the pulley.



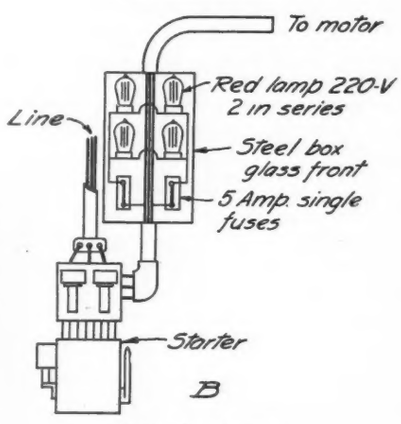
Belt tightener for temporary motor

Copper Shoes Prevent Rust Forming on Crane Rails



A

Copper strips reduce sparking at rails



Red pilot lamps indicate closed circuit

Portable Storage Battery Lamp for Very Damp Locations

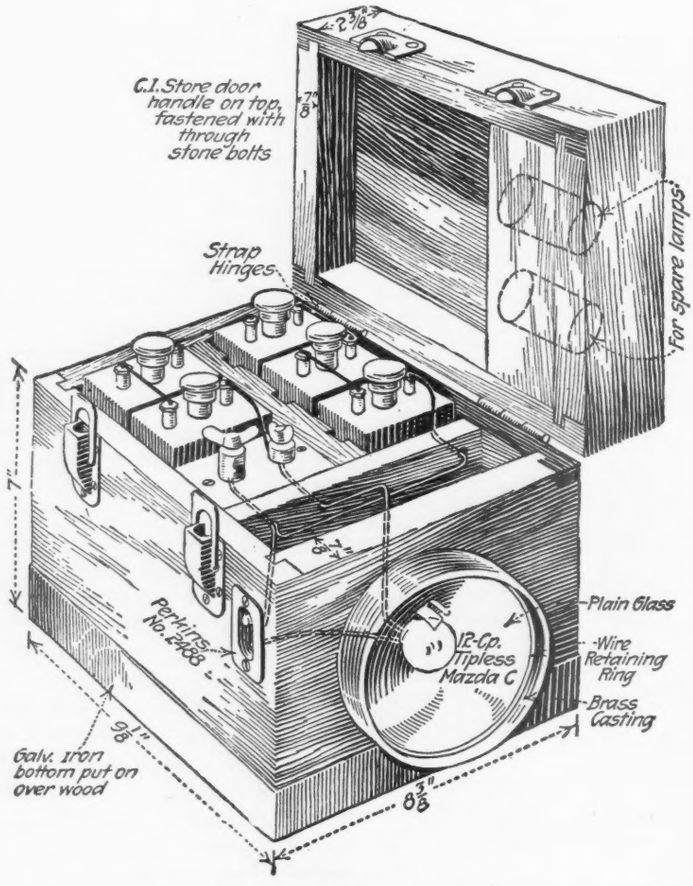
A PORTABLE storage-battery lamp which has been found satisfactory for use in any damp locations is shown here, consisting of a wooden box containing five storage cells and a 12-cp. lamp attached to the side of the box.

The cells used are Edison storage battery M-20, 12-amp.-hr. motorcycle type with rubber insulation. After about a year's service from twelve of these lights it was found that the rubber-insulated cell was likely to give trouble. The boxes were sometimes tipped over and filled with water, and unless they were properly washed out and dried after such an accident, electrolysis made holes in the metal cell-containers.

Accordingly, twenty-four lamps having the same type of cells were built, but without soft-rubber insulation. Hard-rubber buttons attached to the cells were used to hold the latter in grooves cut in the sides and partitions of the box. These lamps were provided with an automobile type of push-button switch mounted so as to be operated from the outside of the box. Binding posts of dissimilar character, which will fit only corresponding wire terminals, are used in charging. The dissimilarity of the terminals on the charging cord insures proper polarity. At first small motor-generator sets were used for this charging, but it was later found more desirable to connect the cells directly to the direct-current circuit in series with resistance units and a rheostat so that the current could be regulated to a strength of 2½ amp. for different numbers of cells connected in series. With this arrangement the charging of the cells is very simple and requires no expert attention.

E. H.

New York City.



Lamp Made for Use Where a Great Deal of Moisture Is Present

Improper Electrodes Will Stick in Operating Brass Furnace

TROUBLE from zinc clogging the electrode holes in a rocking brass burnace of a large brass mill was recently found to be caused by employing electrodes of poor quality. A one-ton electric furnace is used for melting brass in the casting shop. Owing to the high percentage of zinc in some of the mixtures, difficulty was experienced with zinc in a volatile state, cooling around the electrodes and thus clogging the electrode holes, making it impossible to withdraw the electrodes from the furnace. Investigation showed that the trouble was made serious by the use of a poor grade of electrodes, which peeled away at the electrode holes through the furnace and left a large space for the zinc to occupy. Since the use of 4-in. graphite electrodes selected and turned to size there has been no further trouble with the zinc clogging the electrode holes and the energy consumption was reduced from about 300 kw.-hr. to 250 kw.-hr. per ton.

JAMES S. BRUSSTER.

Assistant Mechanical Engineer,
Cleveland Brass & Copper Mills, Inc.
Cleveland, Ohio.

Test for Defective Squirrel-Cage Rotor

AS THE stator of a squirrel-cage motor may be damaged by a defective rotor the test outlined here is made by the writer on motors giving evidence of such trouble. A motor with a defective rotor has a non-uniform starting torque and often refuses to start its normal load, or it may make considerable noise when starting, and if the trouble is quite bad it will spit fire when thrown on and off the line.

When a motor gives such indications an ammeter is inserted in one line and voltage is put across one phase of the motor sufficient to cause the ammeter to read, but the current value should not be so high that it will damage the motor. The rotor is then turned slowly by hand while the meter is watched. If the rotor winding is good, the impedance will be uniform and the meter readings will stay within 1 or 2 per cent, but if there are any defects in the electric circuit of the rotor, the needle of the ammeter will swing back and forth sometimes as much as 40 per cent in bad cases. The

reason for the current varying is that the winding of the rotor acts like a shorted secondary on a transformer but varies in resistance as the rotor is turned and the defective bars pass into and out of the active field, or rather from one phase into another.

The trouble may be due to unsoldering at the end rings or loose or broken bars. It is almost sure to spread after it has once started, and the motor will gradually take more and more current to carry the same load, while the slip of the rotor increases, the efficiency of the motor goes down and the temperature of both stator and rotor increases. If the trouble is not remedied the motor may be very badly damaged.

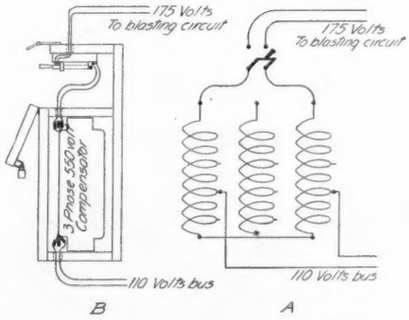
PHILIP C. BERNHOLZ.

East Orange, N. J.

Higher Voltage from Old Compensator Used as Auto Transformer

EFFECTIVE use was recently made of an old 3-phase 550-volt compensator when we needed a higher voltage for our quarry blasting circuit. The middle coil of this compensator had been burned out and was disconnected at the star, as shown in the accompanying sketch *A*. The two remaining coils were then connected as a straight auto-

A—Connections on compensator to obtain higher voltage for blasting circuit.



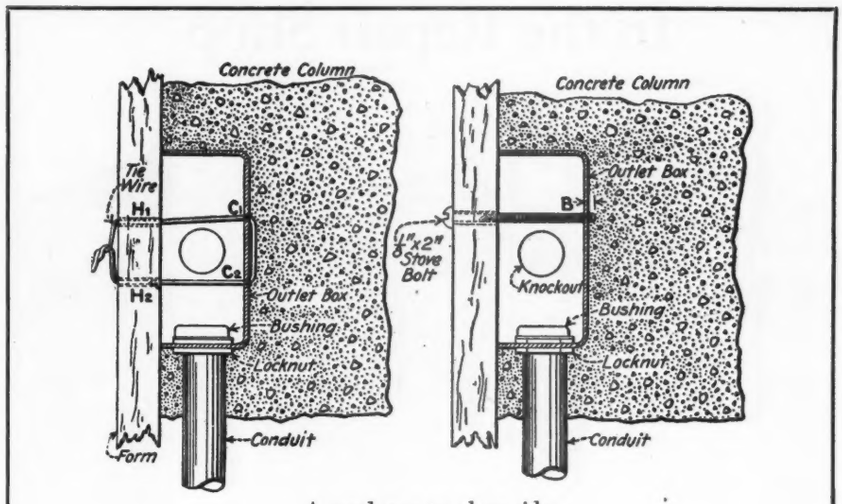
B—Wooden box showing compensator and snug fit of switch.

transformer to the 110-volt lines. The other terminals were connected to the blasting circuit. With the long lines required to reach our quarry we found that 110 volts was not sufficient to set off a heavy blast with a large number of caps in series; but since our new connections gave us approximately 175 volts we have set off blasts of over 100 holes without a miss.

Another feature of interest is the arrangement of the switch to make it absolutely safe and foolproof. Sketch *B* is self explanatory. It shows a view of the wooden box in which the coils and switch are mounted. The switch is mounted so near the front of the box that the cover can be closed only when the switch is opened. The switch box is always kept locked and the man who has to set off the blast is the only one who has a key.

J. H. GALLANT.

Canada Cement Co., Ltd.
Montreal, Que.



A good way to place side outlets in concrete frame

Grouping Cables Behind Switchboards

TO PERMIT grouping cables neatly above one switchboard which the L. K. Comstock Company installed, it attached 3/-16-in. steel plates to each panel support at right angles to the switchboard and then framed these plates with channel irons. Holes were drilled in the plates and nippled so that the cables could be threaded through to their respective switch studs. The top and sides of the framework were inclosed in No. 12 gage steel plates and the bottom closed with transite boards ⅛ in. thick, in which holes were later drilled for feeder drops to the switch studs. This latter operation was not performed, however, until all the rest of the work was done.

E. H.

New York City.

Side Outlets Fastened in Concrete Forms

DIFFERENT wiremen use different methods for attaching side-outlet boxes for (baseboard receptacles, switches, fan outlets, bracket outlets and the like) to the wooden forms before the concrete is poured. Two methods which are used frequently are shown. One involves the use of a piece of iron wire for fastening the steel box to the form. Old bailing wire will serve the purpose, but wire of smaller diameter will answer as satisfactorily. Two holes, H_1 and H_2, are bored through the form board, at the position where the box is to be attached. Then the box is tied securely in place by twisting the ends of the wire which extend through the holes. After the form has been removed, these wires can be severed with a pair of nippers at C_1 and C_2.

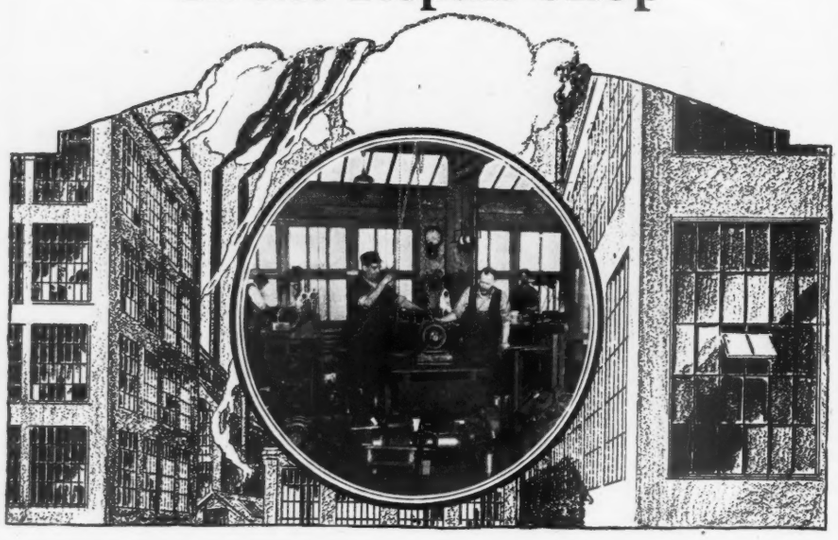
The second method shown makes use of a machine screw sufficiently long to extend through the form board and into one of the tapped holes in the back of the box. The latter arrangement is better, more accurate and more economical where machine screws are at hand. Where they are not the tie wire will suffice.

After the concrete has set and the forms have been taken down, the machine screws can be removed easily with a screw driver. They should never extend very far from the back of the box into the concrete. That is, the distance B in Fig. 2 should not be more than 1/16 in. or ⅛ in.

LYMAN L. AFTON.

Kansas City, Mo.

In the Repair Shop



Large Industrial Plant Maintenance Methods

BY ADHERING to the rule that long successful operation of motors and control apparatus is more economical from a production point of view than a low first cost, the Gillette Safety Razor Company has maintained almost continuous operation for a number of years. Spare parts are kept in stock to provide for any emergency. When new motors are received, if no extra bearings are on hand these are immediately ordered. To have in stock bearings to fit every motor in service is thought by the company to be the cheapest insurance for continuous operation.

Equal in importance to this practice is that of careful and regular inspection, which will contribute greatly to keeping the motors on the line. In the Gillette plant the night electrician cleans, removes and replenishes oil wells and tests each motor with a gage at least once every six months. Motors are inspected as to the proper amount of oil each Monday by the foreman of the electrical department, who is responsible for their external cleanliness.

For quick or emergency connections 100-amp. bulldog clamps are available with 6 ft. of flexible automobile cord connecting one pair. Three pairs are on hand so that a defective switch or compensator can be shunted if necessary.

The cost methods in this plant are as follows: Repair work is charged on the workmen's daily time card, each department having a designated number. The letter R following this number indicates repairs. If new apparatus is installed, the letter P is indicative. Stock is kept in the electrical department storeroom, and its cost is recorded on a card index file and charged to the job when finished. A large job has a special ticket, and the workmen charge their time on their cards to this number. When the job is completed a list of stock is tabulated and charged off, and the card is sent to the office marked "finished," with the head of the department's signature.

I. H. GASKIN.

Gillette Safety Razor Company,
South Boston, Mass.

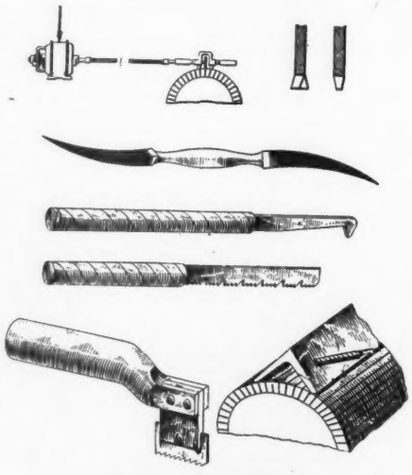
Characteristics and Uses of Air-Drying Insulating Varnishes

THERE are two different types of air-drying varnishes—those made with a benzine solvent and those made with an alcohol solvent. The latter are commonly called spirit varnishes or finishing varnishes. The benzine solvent air-drying varnishes are not oil-proof. The alcohol solvent varnishes are made from materials which are insoluble in oil and are therefore oil-proof. They dry much more quickly and are harder, but are not equal in elasticity and heat resistance to benzine solvent varnishes.

The physical characteristics of varnishes of the same color and having the same baking time are not necessarily the same. Electrical apparatus is subject to many different conditions of usage, and it is necessary that the varnish be strongest in those particular characteristics which will be most needed. For example, a street-railway motor is exposed to the action of rain and snow on steep grades, and during periods of heavy traffic it is overloaded, with resultant heating. A varnish to be successful on such a motor must be extremely water-resisting and must possess the longest possible life under heat. An automobile-starting motor armature which operates at a speed of from 10,000 r.p.m. to 12,000 r.p.m. requires a varnish possessing extreme mechanical strength and binding and cementing properties. Other characteristics, while important, are subordinate to these. In choosing a varnish for any particular work the usage to which the equipment will be subjected should be taken into careful consideration.

Undercutting Tools Made From File and Hacksaw Blades

FOR undercutting commutator mica industrial plants with a large number of motors can make some very handy tools for use on armatures taken out of the frame and on armatures which are to be worked on in place. For small armatures which can be taken from the frame a circular saw about 1 in. in diameter driven through a flexible shaft facilitates work. The "set" of



Undercutting tools made in the shop

the saw should be ground off and a guard provided to limit depth of cut to about 1/32 in.

For working on an armature in its frame a hand tool is better. A thin three-cornered file may be used to start a groove in the mica, after which the file or a hack-saw tool

shown in the drawing may be used to deepen it. A silversmith's "riffler," which is a curved double-ended file, may be employed. Some experienced men consider that a straight edge and a hook are the most efficient tools. The edge of a piece of angle-iron longer than the commutator will be parallel to the slot and is a very handy straight edge. For a hook a hacksaw may be ground into any of several different shapes and a handle formed of tape or wood taped on the blade. About four good strokes with a sharp hook will remove 1/32 in of ordinary mica, which is about the proper depth.

Transformer for Locating Motor Troubles

FOR locating short-circuited coils in induction motors and for testing small direct-current motors the home-made testing transformer shown here has proved successful in a New York repair shop. For use on a 110-volt, 60-cycle circuit this transformer is wound with 150 turns of No. 10 B. & S. gage square double-cotton-covered magnet wire. For 220 volts, 60 cycles, 300 turns of No. 13 is used and for 110 volts, 25 cycles, 356 turns of No. 14. The core is of H-shaped laminations measuring 5 in. x 6 in. over all. These are built up to a depth of 3½ in. and are held together by ¼-in. bolts which are insulated from the laminations by paper or tape bushings and washers. In making the core, blank laminations 5 in. x 6 in. may be bolted together after the holes are drilled and the whole core may be milled to shape in one operation. After milling, all burrs should be removed with a file.

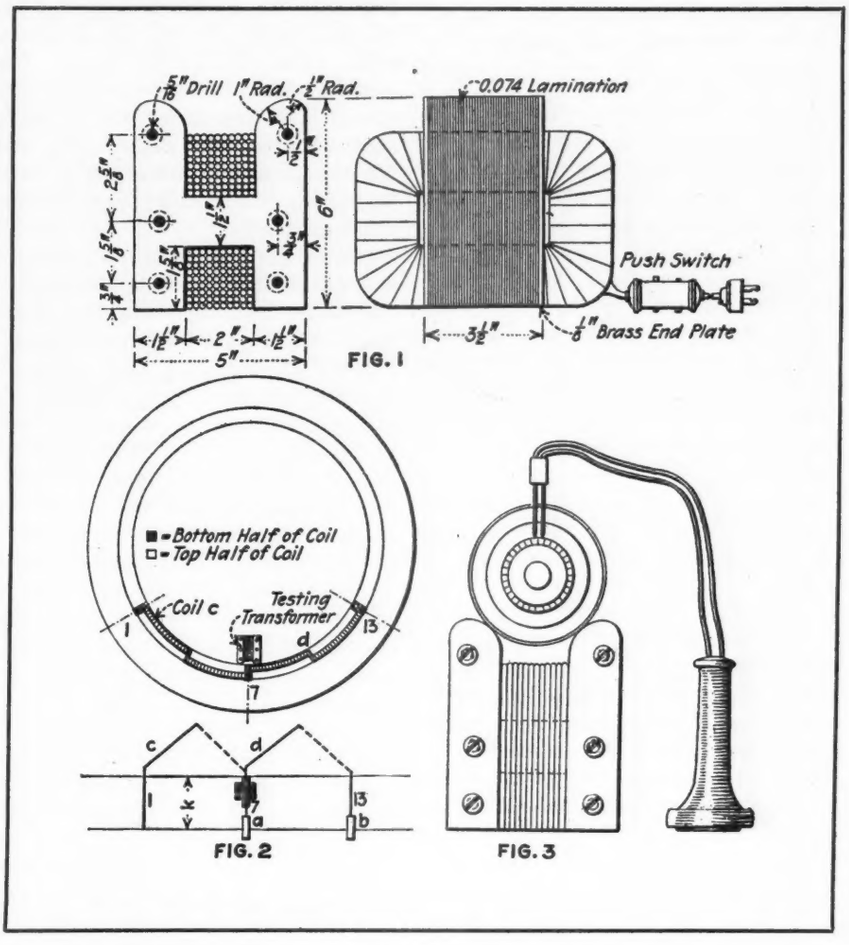
In winding the coil a fiber or bakelite sleeve should be put around the core. After each layer is wound it is painted with bakelite and baked. When the winding is completed the coil is bound with friction tape or a band of ⅛-in. cord. A snap or push switch in the connecting cord facilitates shifting the transformer when testing large motors.

When testing with this transformer for short-circuited coils of induction-motor stators, the transformer is used as in Fig. 2 in conjunction with a steel feeler which is a thin piece of steel or iron about ½ in. x 5 in. When the transformer is applied over a leg of a short-circuited coil, the feeler is pulled to the core by magnetism when it is laid across the slot containing the coil. To locate a short circuit in a two-layer winding as shown in Fig. 2 if the feeler vibrates when bridging a certain slot, then one of the coils in that slot is short-circuited. The other side of the grounded coil may be found by testing the slots on each side at a distance away equal to the pitch of the coil. For example, in Fig. 2, after the feeler vibrates at slot No. 7, then if it vibrates also at No. 1, the bad coil is located at *c*. In case of a motor whose core is less than the length of the transformer, 3½ in. across *k*, the feeler must be applied to the slot one coil pitch away, as at *b*, rather than *a*. The best method for testing is to pass the transformer around the stator, slot by slot, marking with chalk each slot at which the feeler vibrates. After this is done all the defective coils are located.

For testing small direct-current armatures about 2 in. to 4 in. in diameter the transformer is placed on a bench and the armature is placed in between the poles as in Fig. 3. Short circuits may be located with the feeler placed on the top of the motor directly above its center in the same way as they are located on alternating-current stators already described. For locating reversed leads and open coils as well as short circuits, a bar-to-bar test is made, revolving the motor between the poles. For this test a telephone receiver or a flashlamp is used connected to two points of a testing fork which spans one commutator mica segment. This fork is always kept within two or three bars of the top of the commutator while the armature is revolved a step at a time. Any change in the tone of the telephone or in brightness of the lamp indicates that a coil is defective. The practice of the writer is to make the feeler test before soldering the commutator leads.

C. A. JOHNSON.

Bronx, N. Y.



Figs. 1, 2 and 3—Locating troubles in alternating-current and direct-current motors

Fig. 1—Construction details of testing short circuits in an alternating-current transformer. Fig. 2—Method for locating stator. Fig. 3—Test for small direct-current armature to locate short circuits, reversed coils and open circuits.

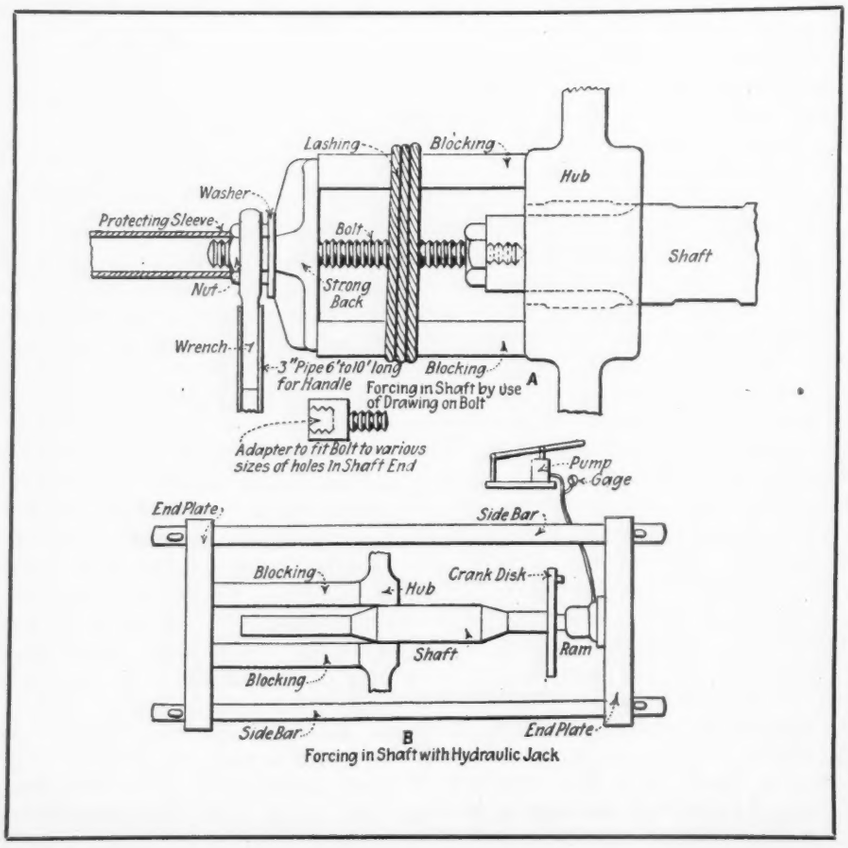
Screw Device for Forcing Armature on Shaft

FOR forcing an armature on a shaft the screw device shown in the accompanying illustration has been successfully used in an eastern repair shop. This device consists essentially of a 3-in. special screw or bolt, one end of which is fastened into the shaft, the other end having a nut which is screwed against a push plate and blocking that in turn bears on the armature, pushing it on the shaft. In using the device the bolt is first screwed into the threaded hole in the end of the shaft. If it does not fit, it is necessary to use an adapter having a screw on one end which fits the shaft and a threaded socket on the other end which fits the bolt. When this bolt is mounted in the shaft an iron push plate, or "strong back," is fitted over the bolt and the nut is screwed up against this plate with a heavy washer between them. Then hard-wood blocking is placed between this plate and the hub and the bolt is tightened. It is well to lash the blocking in place with rope to prevent buckling. By means of a wrench and a piece of pipe used as an extension handle the nut can be screwed up on the bolt, forcing the hub onto the shaft. Use of a 3-in. bolt will easily give 90 tons pressure with a handle 10 ft. long. For medium-sized shafts the pressure required is 40 tons to 50 tons. Larger shafts take as high as 125 tons, and for shafts with a bore larger than 14 in. the use of a hydraulic press is recommended.

Before forcing a hub on a shaft the diameter of each is measured. The shaft is always slightly larger than the hole in the hub, usually 0.00025 in. for each inch of shaft plus 0.001-inch. If the difference is greater, the bore must be increased by scraping or the shaft must be reduced to prevent jamming. Micrometers are used to measure this allowance, or a pin gage may be made for the hub and the shaft measured with a feeler gage. If the difference is correct, before the forcing is started the tapped hole in the shaft, the bolt and the shaft and bore must be cleaned and oiled. A thin mixture of oil and white lead is applied to the shaft and the washer should be lubricated with a graphite grease before starting. In order to prevent injury to the bolt when shifting the wrench, a protecting pipe sleeve is placed on the bolt behind the nut.

For shafts that are 14 in. in diameter a hydraulic pump and ram, arranged as shown, may be employed. to produce the high pressure necessary. The end plates of the frame are I-beams bolted together or heavy wooden beams, and the side bars are steel bars, rails, cables or chains.

Cleveland, Ohio. JAMES DIXON.

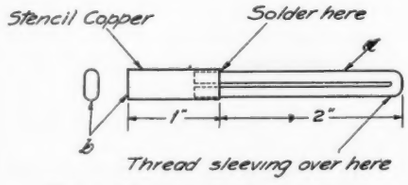


Methods for forcing an armature on a shaft above, with screw; below, with ram.

A Way to Reduce Costs of Threading Cotton Sleeving on Armature Coils

THE accompanying sketch illustrates a guide devised for facilitating the threading of tubular cotton sleeving over the ends or leads of armature or stator coils. As an example, take the case of an armature wound with two No. 10 wires in parallel. From the sketch it will be noted that *A* is a piece of the same size of wire as used for the coils; the cotton covering has been removed and the wire bent double in the form of a hairpin, the bend being squeezed so that the two wires come closely together. Then *B* is formed into a tube from a piece of stencil copper (such as is used for clips on armature bands) by bending same around the end of the double wire, the edges butting and not overlapping.

In the present instance the tube is 1 in. in length, so that when the doubled wire is pushed half way



This guide is made from a piece of wire and stencil copper.

through and then soldered, the other 1/2 in. serves the purpose of a socket to slip over the armature leads. Care should be taken to remove all superfluous solder and to see that there are no sharp edges. The guide should be smoothed over with a smooth file.

The directions for using this guide are as follows: See that the number of wires over which a single piece of sleeving is to be threaded are the same length; then slip the guide over the ends and thread on the sleeve. It follows that

a separate guide must be made for coils wound with different sizes of wire, and also for the number of wires in parallel over which one sleeve has to be threaded. They can be made in a few minutes, however. For coils wound with wire of rectangular or square section, the guide is made in exactly the same manner, except a tube is formed around a single piece of the conductor, the opposite end being smoothed off. The use of this device in the writer's own shops has reduced the over-all time of making sets of armature coils out of all proportion to any other kind. L. E. WOOD.

Airedale Elec. Mfg. Co., Ltd.
Bradford, York, England.

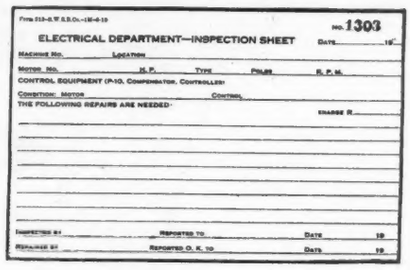
Testing Low-Resistance Coils With Telephone Receiver

WHILE overhauling an equipment of series motors in a steel mill a quick and reliable means of testing the field coils for short circuits was desired. For this purpose a method which proved quick and accurate employed a telephone receiver to detect any difference in the induced currents in the tested coil and a coil which was known to be good. For inducing the current in the coils an E-shaped laminated-iron core, taken from an old transformer, was used. Over one end of this core was placed the good coil and the coil to be tested was placed over the other end leg. These two coils and the telephone receiver were connected in series in such a way that the voltages in the coils induced by an exciting coil on the middle leg were in opposition. When the exciting coil is energized, if the coil under test is not short-circuited, the voltage induced in it balances that of the good coil and the telephone receiver is quiet. If there are any short-circuited turns, the voltages will not balance and a buzz will be heard in the telephone. The exciting current in the middle coil may be furnished from a 110-volt alternating circuit or, when no alternating-current supply is available, by direct current interrupted by a common doorbell or buzzer. If the 110-volt alternating current is used, the exciting coil must have sufficient resistance to prevent heating, while a coil used with an interrupted dry battery current need not have a high resistance. JAMES DIXON.

Cleveland, Ohio.

Inspection Reports Insure Prompt Action

RATHER than depend on the inspector's memory to note apparatus needing attention, the electrical department of the Southwestern Shipbuilding Company, East San Pedro, Cal., has effectively used the form of inspection report shown. A pad of these sheets, serially numbered, is carried by each inspector on his daily rounds of oiling and inspection. The troubles usually encountered in the plant, which operates about 250 motors of many different sizes, are low bearings, broken or damaged controllers, damaged switches, broken wires, loose connections to motors, controllers, switches or fuses, and motors running hot. When trouble is found the proper blank space is filled in and the character of needed repairs noted. The reports are made in duplicate and both are taken to the maintenance foreman's office, which enters the repair charge number and indicates when the repairs shall be made. The original copy is delivered to the repairman, while the duplicate is held until the repairs are made and the original returned. The originals are filed according to the repair charge numbers, thereby constituting a record of the several accounts. A. G. HUMPHREY.


ELECTRICAL DEPARTMENT—INSPECTION SHEET
No. 1303
Date ..... 19..
Machine No. ..... Location .....
Motor No. ..... H. P. ..... Type ..... Poles ..... R. P. M. .....
Control Equipment (P-10, Compensator, Controller) .....
Condition: Motor ..... Control .....
The following repairs are needed: ..... Engineer R. .....
Inspected by ..... Reported to ..... Date 19
Repaired by ..... Reported O. K. to ..... Date 19

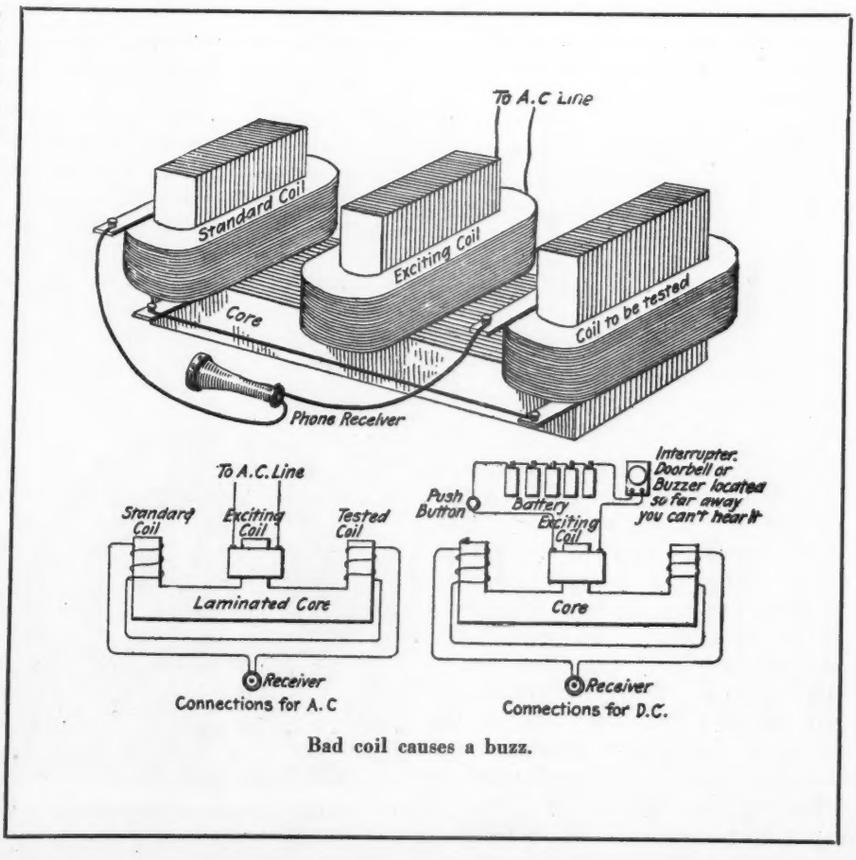
This card provides for the listing of all types of motor troubles.

Electrical Engineer.
Southwestern Shipbuilding Company,
East San Pedro, Cal.

Portable Testing Table

THE portable testing table shown in the accompanying illustration has been used by the writer eight years and has been found very satisfactory. This table, with current transformers, polyphase wattmeter, ammeter and voltmeter, is wheeled to the motor to be tested and connected thereto by dummy fuses and flexible cable leads attached to the testing table at *A* and *B*.

The instruments are connected in the motor circuit by removing the live fuses and allowing the motor to run single-phase an instant while re-



Bad coil causes a buzz.

placing with the dummy fuse properly connected. The other leg of the line is connected in a like manner. Potential leads are connected by lamp cord to the middle leg of the line. All conductors on the front of the board are of polished copper bars 3/4 in. wide and 1/8 in. thick.

The dummy fuses are made from standard fuses of the sizes used in the plant. The fuse wire is removed and the interior is filled with sealing wax so that the fuse will keep its shape under continuous handling. If the fuse is of the knife type, the blades are soldered to the end ferrules in order to insure solidity and good connection. The leads are soldered to the ferrule and a small copper strip is bolted around them to keep them from pulling off.

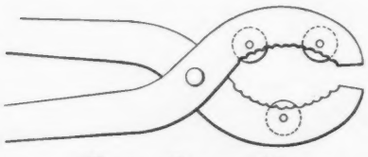
I. H. GASKIN.

Electrical Engineer.
Gillette Safety Razor Co.,
South Boston, Mass.

Porcelain Tube Cutter Made From Gas Pliers

SOME time ago the writer built a porcelain tube cutter from a pair of plumbers' pliers which has served its purpose very well. While tubing can be cut by using an emery wheel, it is next to impossible to file porcelain, so that this portable cutter comes in very handy.

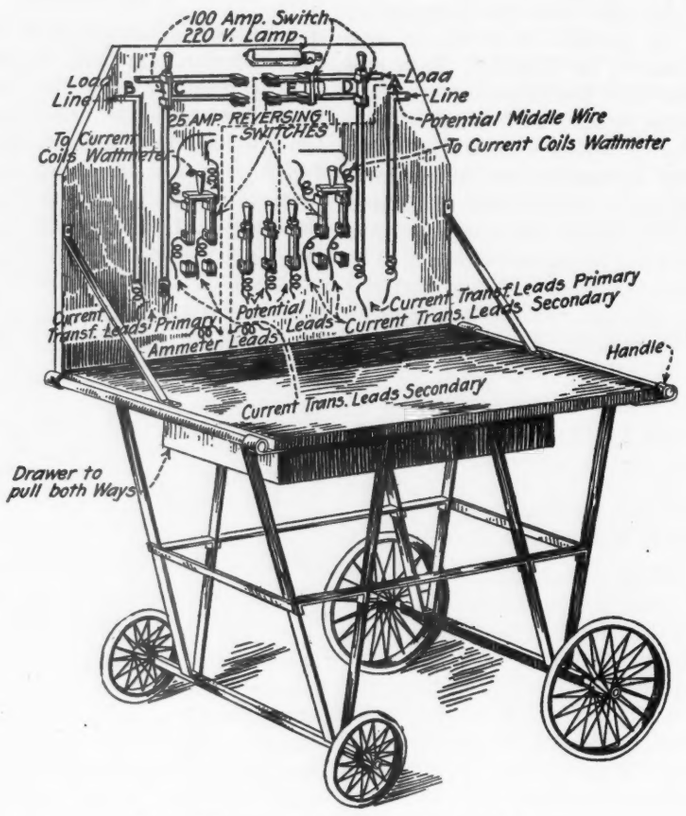
An 8 or 10-in. pair of gas pliers is provided with two small wheel cutters in one jaw, and one in the other. These cutters can either be made and tempered, or purchased from some pipe cutter manufacturer. With two or three hack saw blades



Three rollers provide good cutting surface.

fitted together into one frame, saw a wide slot down through each jaw of the pliers, far enough to take two cutters on one and one on the other. Then with a small drill, bore a hole to take a pin large enough to allow the cutter to run true. When cutting a tube, grip the cutter tightly and turn it around, which will cut in a fine, sharp line. If the tube is now struck sharply down over an edge it will break right on the line, like a glass tube.

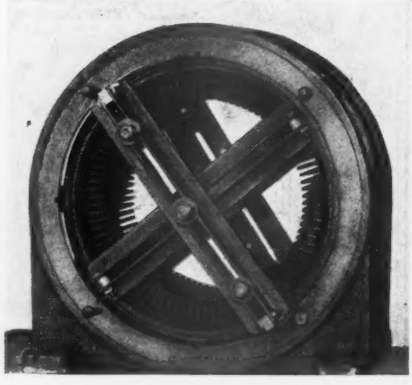
Little River, Conn. H. S. RICH.



Test table may be rolled to motor switch.

Angle Iron Clamp for Restacking Laminations

RESTACKING the laminations of motors which have been damaged is facilitated in an English industrial plant by use of a clamp made of angle irons. This clamp consists of two halves which press at four points on each side of the stator laminations when the tie bolts are tightened. Each half of the clamp is made of two crossed members, each consisting of two angle-bars bolted together as shown. The clamp is adjusted against the lock rings at each side of the lamination, the latter being carefully aligned by the aid of a steel gage the size and shape of a slot before the bolts are tightened. When a solid sound is produced by tapping the laminations with a hammer they are sufficiently compressed. After the keys which hold the lock rings are fitted in place the clamp is released.



Clamp compresses laminations while rebuilding stator.

Bradford, York, England. L. E. WOOD.

Desirable Properties in Insulation

IN selecting insulation for electrical rotating machinery the following properties must be investigated: (1) High insulating quality; (2) ability to withstand mechanical strain; (3) ability to withstand vibration; (4) flexibility; (5) longevity; (6) ability to exclude moisture; (7) ability to withstand heat; (8) ability to withstand acids; (9) adaptability to use in small space, and (10) good heat conductivity.

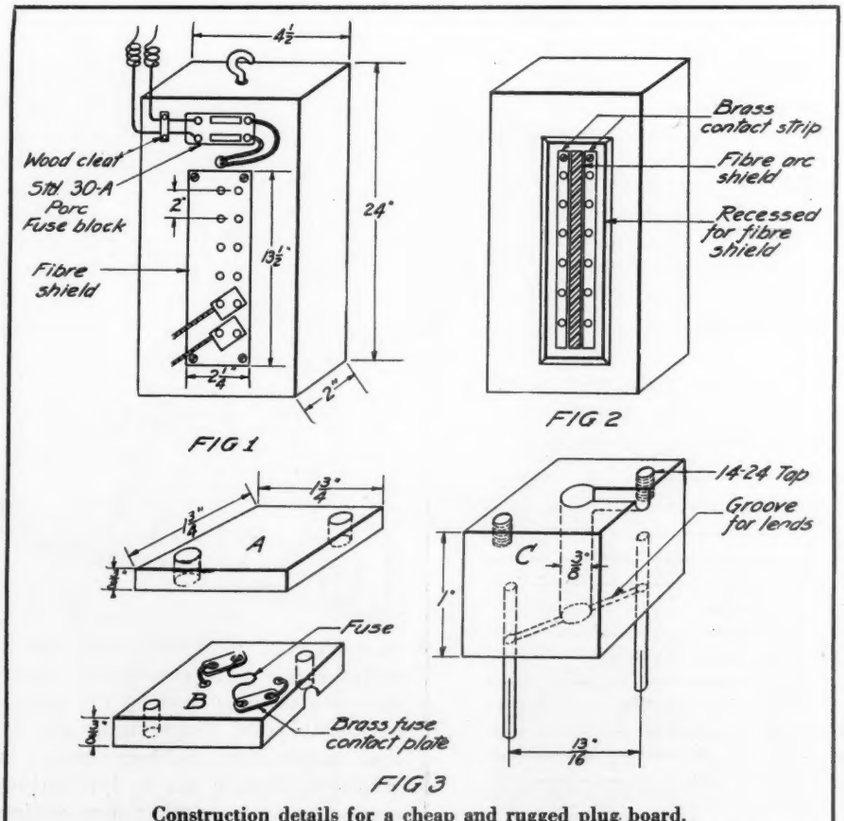
A Cheaply Built Plug and Plug-Board Designed for Hard Service

A VERY rugged plug and plug-board was built in a large shipyard on the Delaware to provide a flexible yet sturdy medium for changing circuits for portable lamps, drills and grinders. In ship construction work the standard attachment plugs and receptacles were not suited to the severe usage given them, so that the following equipment was built. This plug-board is fool-proof, very simple to construct and also shock-proof. If more circuits are required another board can readily be placed in parallel with the line circuit.

A wooden block, 24-in. x 2-in., is cut out as shown in Fig. 2 so that two brass strips can be mounted 1/4 in. below the surface of the board. Then 3/16-in. holes are drilled for the contact tips and a fibre arcing shield placed between the two strips. A sheet of 1/4-in. fibre, with clearance holes drilled to register with those in the brass strips, is set in the depression and screwed fast. A 30-amp. porcelain fuse block is mounted at the top, with a wooden cleat to take the strain from the screws.

The plug is made of three pieces of fiber, as shown in Fig. 3, a base, a fused piece and a cover. The cover is hollowed out to clear the fuse and screws. The contacts are made of two pieces of 3/16 in. half-round brass, forced into the base and spread slightly to give a firm contact. For a portable lamp a 1/2-ampere fuse is used; heavier fuses as needed may be used for drilling machines, etc. Ordinary labor will not attempt to replace any fuses and an authorized person can do so very quickly. If suitable cord is used (such as brewery cord) it will seldom break at the plug.

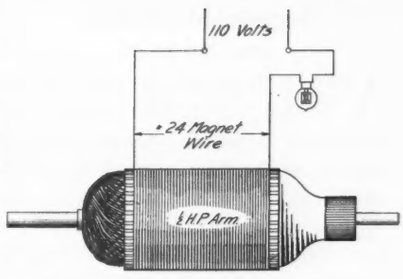
Camden, N. J. L. C. BEATY.



Construction details for a cheap and rugged plug board.

How to Dry Out An Armature When No Oven Is Available

HAVING rewound a 1/2 hp. armature, some means of drying it out were sought. As there was no oven handy, and since it was inadvisable to run heating current through the coils, the armature was wound over with a layer of No. 24 double-cotton magnet wire, as illustrated. A lamp in series with this winding on the 110-volt circuit allowed proper current to flow, warming up the armature to about 100



Layers of magnet wires serve as heating pads

deg. C. The increased resistance of the winding, and radiation of heat kept the current and temperature down to a fairly constant value.

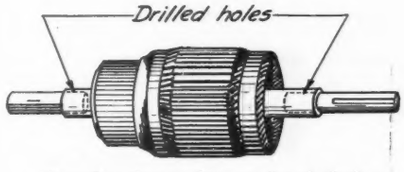
DEXTER W. ALLIS.

Whitman, Mass.

Plugging Shafts of Small Armatures Proves Reliable and Inexpensive

IN the maintenance department of a large manufacturer the shafts of small motors whose bearing surfaces were badly worn, were repaired by plugging. The damaged shaft is cut off and drilled, as shown in sketch. A new piece of shaft is made up with a plug on the end; the plug being made from .005 to .007 inch larger than the drilled hole. The plug is then forced in, using from two to five tons' pressure, depending on the size of the shaft, and the whole shaft trued up in the lathe.

This method has been used in a large number of cases and has always proven satisfactory. In the case



New bearing-surface ends of shaft easily forced into drilled recesses.

of armatures larger than 5 hp., plugging can be resorted to as a temporary expedient, but it is advised that the old shaft be pressed out and a new one pressed in as soon as possible. However, with small armatures plugging produces an absolutely reliable and inexpensive job, but the only consideration necessary is to make sure that the pressure used to force in the plug be not less than two tons.

EUSTACE C. SOARES.

Electrical Engineer.
Ophuls, Hill & McCreery, Inc.
New York City.

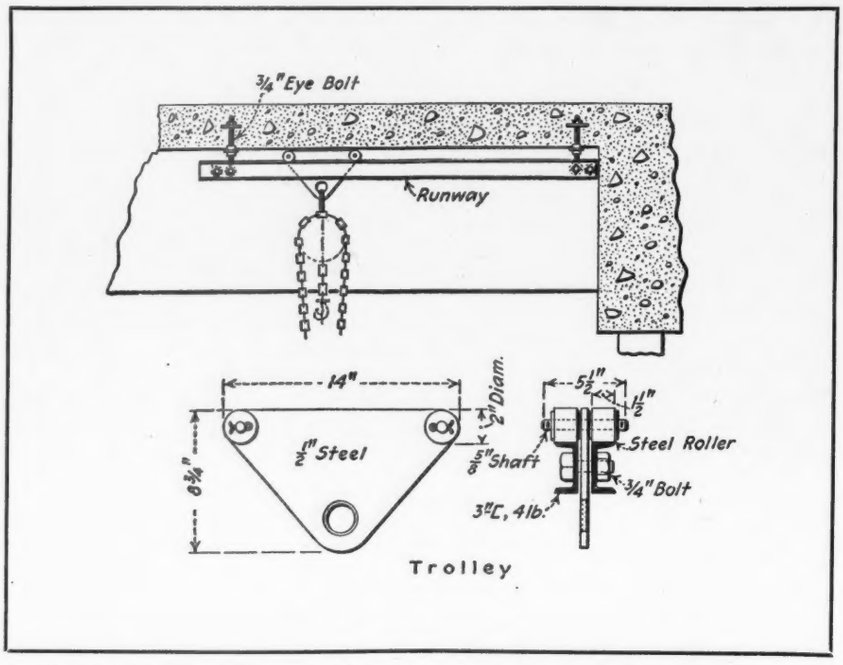
Serviceable Trolley and Runway

AN INEXPENSIVE runway and trolley which has proved very successful in moving heavy pieces of apparatus in a St. Louis shop is supported by eyebolts fastened to the ceiling. Channel irons bolted on each side of the eyebolts form the runway, and the trolley consists of a triangular piece of steel suspended from and between the channel irons on four rollers at two corners of the trolley. A chain block is hooked into a hole at the lower corner of the trianguar trolley for the purpose of raising the load, which can then be pushed along. If a greater distance must be traversed than the length of runway between two points of support the load is lowered when the eyebolt is reached and picked up again on the trolley from an adjacent runner.

The eyebolts were cast in position in the concrete ceiling as shown in the illustration. This installation was designed to lift 4,000 lb.

WALTER H. MILLMAN.

St. Louis, Mo.



Details of trolley and runner for handling heavy electrical machinery

Clear-Cut Equipment Records Facilitate Maintenance

MOTOR and control record cards are used in great variety today to enable better supervision of operating conditions and repair costs to be maintained. A convenient form, unusually clear in its arrangement, is employed at the factory of the American Bosch Magneto Corporation, Springfield, Mass. The usual card index arrangement is used with an equipment card record, 6 in. by 8 7/8 in., in standard size, and carrying space for factory numbers, departmental data, particulars of motor ratings, drive details, etc. On these cards more than half the space is allotted to records of installation and repair work, including comments on equipment history. Since there are 273 motors in this plant, with a total connected load of 1535 horsepower, motor cards are filed by motor ratings—all 5-hp. cards being together, etc. H. K.

Boston, Mass.

American Bosch Magneto Corporation Inv. No.....

ELECTRICAL EQUIPMENT RECORD

Description

Dept.	Form	Phase HP	Part Nos.
Serial No.	Cycles	Maker's Name	Pulley End Brg lin
Style No.	Volts	Speed no load Full load	Front " " "
Type	Amps.	Price	Starter Coil Spec.
			Rotor "

Date Installed	Date Repaired	Repaired by

Remarks

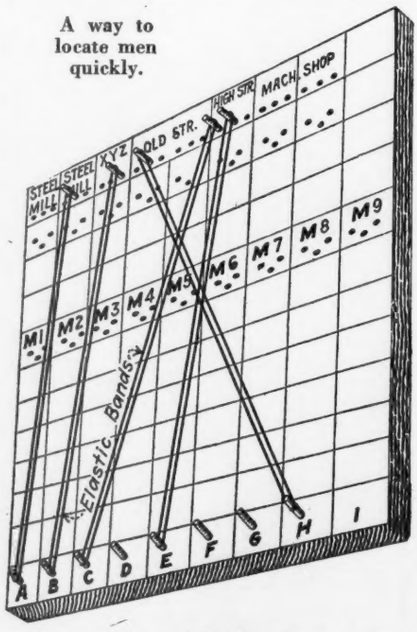
204 A1 8-23-20 500

All necessary information is furnished at a glance on this card.

Chart Tells Where Troublemen Are

FOR showing at a glance the location of the men who maintain electrical crane equipment in the Fore River yard of the Bethlehem Shipbuilding Corporation a simply constructed board is employed. At the bottom of this board (see illustration) are a number of sections

A way to locate men quickly.

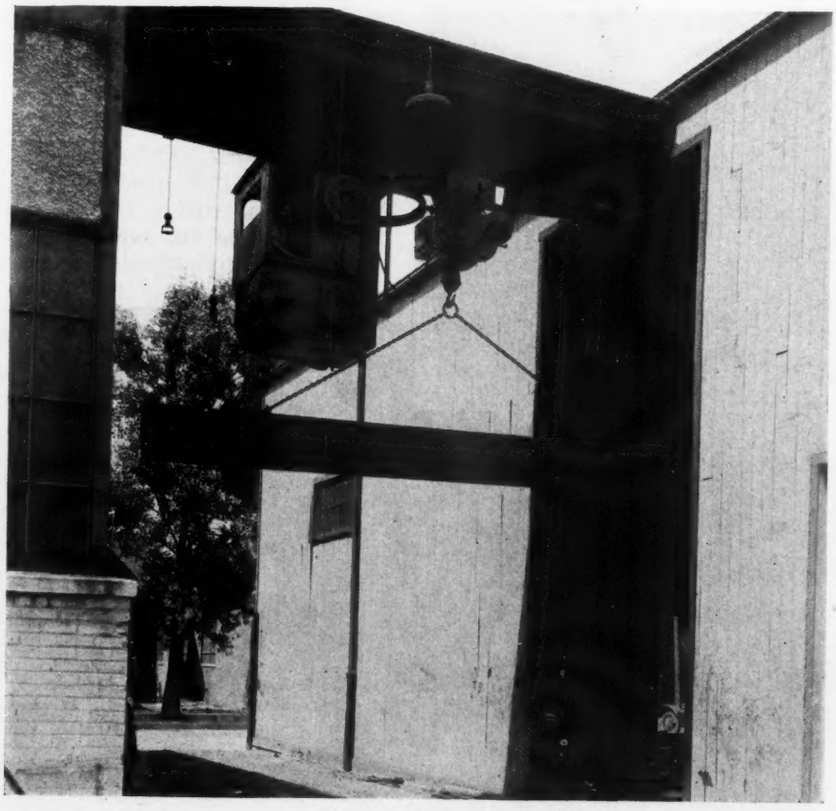


each marked with the name of a maintenance man, and in the upper part are sections bearing the names of the different shops, mills, etc., in the works. A rubber band is stretched from a pin in the bottom section to a pin in the upper section to show where the man has gone.

Handling Materials

Electric Tractor Saves 50 Per Cent at Unloading Pier

MORE than 50 per cent of the cost of unloading at a pier in the North River, New York City, was saved by using an electric tractor and five trailers in place of hand trucks. At this pier about 120 tons of freight are now handled every day at a cost of 0.264 cent per ton, while the former cost of moving by hand trucks was .056 per ton. A saving of 0.296 cent a ton was thus made in spite of the fact that only five trailers were in service, which is only about one-tenth the proper number. These trailers have platforms on a level with the tailboards of the street trucks which haul freight. It is noticed that when such trailers are used the driver of the street truck places boxes or packages on the trailer, while when hand trucks were used he would place the articles on the tailboard of his vehicle and wait for the freight handlers to unload them onto their hand trucks. Use of the tractors thus leaves at least one freight handler free for other work.



Electric Hoist Beats a Hand Crane By $7,000 Per Year

MOST people know that electrical machinery has often saved money and labor in handling materials in factories, but this fact is brought out most forcibly when we see an example like that of Murray W. Sales and Company, Detroit, where $7,000 in wages alone has been saved each year since one hand-operated crane was replaced by an electric hoist. This should remind other operating superintendents in other plants of the saving possible by such a change. Besides this saving in labor, the storage capacity of the plant was increased 100 per cent, as the electric hoist allowed the use of practically all of the floor space and the material can be piled considerably higher than it could by the former method.

This company stores a large amount of pipe and fittings for plumbing and mill and factory supplies. The hoist operates inside of and between three buildings and it carries pipe to and from the furnaces used to heat pipes before bending.

The hoist is a Shepard two-ton cage-controlled machine with the trailer type of cage on which no motor is mounted. Cage and hoist run suspended on an overhead I-beam.

Perhaps the words of the man who is responsible for handling the materials in this company will give a better idea of the service that it gives, therefore the following extract of a letter from him is presented. W. Byas, who is foreman of the works and heartily in favor of this way of handling material, says:

"Our hoist is saving us approximately $7,000 yearly. We installed it about two years ago, having replaced a hand crane with it. Since that time the Shepard has required no repairs except the replacing of a broken disk, which was practically nothing.

"The hoist operates in and between three buildings in our yards and to our loading docks, handling pipe and pipe fittings, and in addition it feeds the

He loads 5 tons in 10 minutes.

This operator is only one of thousands who sit in their little cabs and do easily what were back-breaking and time-eating jobs a few years ago. He can carry a ton easier and quicker than you can carry a pound.

furnaces where our pipes are heated and bent.

"By installing this equipment we have increased our storage capacity at least 100 per cent, and we now can use every bit of floor space and pile our pipes considerably higher. Our hoist can load on to a truck ten 15-ft. lengths of 10-in. pipe weighing half a ton apiece in about ten minutes, including the time required to run into the warehouse. Formerly this required several men at least two hours.

"The hoist has replaced at least six men in our yard and is saving us, therefore, approximately $7,000 yearly in wages alone. Of course, the increase in storage space and general efficiency amounts to another considerable item. We cannot speak too highly of our hoist and the work it does for us."

Cutting Cost of Coal Handling

ALL industrial plants have more or less coal to be handled. One of the problems often met is that of taking coal from the pile and loading it on cars, trucks or conveyors. Any industrial man who has such work to do will be interested in the method used by the Baldwin Coal Company, Kenosha, Wis., where coal is loaded onto trucks at a cost between 8 and 9 cents per ton, which is about 12 per cent of the cost when loading was done by hand. Now the loading is done by two motor-driven loaders which can be moved from one section of the pile to another.

Loaders of this character are especially valuable where an expensive type of coal handling apparatus cannot be considered. In such cases the coal from storage piles is ordinarily handled from the pile to conveyances by hand. With the ordinary type of narrow-gage car, truck or horse-drawn vehicle this is a slow and expensive process. Where there is no means of getting coal from the railway car into the boiler room except by hand shoveling the handling cost is also high. In such situations this type of loader, or the similar type of conveyor with a reach of 60 ft. or more, can many times be applied profitably when no other form of mechanical equipment is justified because of the comparatively small amount of coal handled.

Two types of this machine are operated. A type *A* loader used for nut-size coal handles about 4,000 tons per year, while a type *C* loader used for other sizes of hard coal handles about 3,500 tons per year. These two loaders prevent loss of time while moving from one coal-storage bin to another. The type *A* loader was purchased in December, 1914, and the other one in July, 1915.

These machines can load a 2-ton truck in 5 minutes.

Although 63 cents per ton may not be saved in every case as was done by the Baldwin Coal Company. However, wherever loose material taken from piles or bins, similar motor-driven machines may more than pay for their installation.

What It Costs to Load Coal by Electrically Driven Loaders

Total Expense of Wagon Loader—Type A

Depreciation ($571 ÷ 10....	$57.10
Average yearly interest at 6 per cent (11 ÷ 10) x (571 x .06) ÷ 2.....	18.84
Repairs and maintenance....	25.00
Taxes (.021 x 571).....	11.99
Insurance	18.00
Power (4000 ÷ 24) x (2.75 kw. x .05).....	22.92
Labor (4000 ÷ 24) x (2 x 60)	200.00
Total annual charges.....	$353.85
Cost per ton (353.35 ÷ 4000)	$.0885

Total Expense of Wagon Loader—Type C

Depreciation (350 ÷ 10)....	$35.00
Average yearly interest at 6 per cent (11 ÷ 10) x (350 x .06) ÷ 2.....	11.55
Repairs and maintenance....	25.00
Taxes (.021 x 350).....	7.35
Insurance	12.00
Power (3500 ÷ 24) x (2.75 kw. x .05).....	20.05
Labor (3500 ÷ 24) x (2 x .60)	175.00
Total annual charges.....	$285.95
Cost per ton (285.95 ÷ 3500)	$.0817
Cost of hand-loading (7500 ÷ 2) x .60.....	$2,250.00
Cost of motor truck waiting (7500 ÷ 2) x (25 ÷ 60) x 2.00	3,125.00
Total cost of hand-loading..	$5,375.00
Cost of operating type *A* loader	$353.85
Cost of operating type *C* loader	285.95
Total cost of handling.....	$639.80
Annual saving	$4,735.20
Saving per ton	$.6314

In calculating the yearly cost of operation, depreciation is figured at

ten years. Therefore the annual depreciation charge on the type *A* loader is taken as one-tenth of $571, which was the initial cost of this machine. Interest on investment is 6 per cent. Twenty-five dollars a year is allowed for repairs and maintenance, including painting and overhauling. Each machine can load a two-ton truck in five minutes, which is at the rate of 24 tons an hour. Since the power consumption is about 2.75 kw., at 5 cents a kilowatt-hour this brings the cost to $22.92 for the 4,000 tons per year. Labor charges for two men at 60 cents per hour are $200 a year. Summing up these charges gives a total for the type *A* loader of $353.85, which amounts to 8.85 cents per ton handled.

Depreciation on the type *C* loader is $35 a year when its original cost of $350 is distributed over a ten-year life. The power cost is $20.05 for the 3,500 tons per year, and two men at 60 cents an hour make a labor charge of $175 a year. The total charges for the type *C* loader is $285.95 a year, which amounts to 8.2 cents a ton handled.

When these costs are compared with the cost of hand labor for doing the same job the great advantage of using such equipment is clearly seen.

An average laborer can shovel about two tons an hour into a truck, and since he gets 60 cents an hour it would cost $2,250 a year in labor alone just to load the 7,500 tons on the trucks. There would probably be two men on this job at a time, so it would take only a half hour to load each truck; but the mechanical loaders can do the job in five minutes, so there would be twenty-five minutes lost on each load. On a rental basis the truck time is worth at least $2 an hour; therefore, there is a saving of $3,125 a year on motor truck idling-time alone if this item is considered. Adding this item to the cost of hand labor, there is a total shovel-method cost equal to $5,375 a year. Since the loaders are doing the same work for $639.80 a year a blanket saving of $4,735.20 is obtained—63.1 cents per ton delivered. At this rate the loaders are returning their original cost more than five times a year—over fifty times during their estimated life of ten years. If no charge were made for idle trucks the saving would still be $1,610.20, or 21.5 cents per ton.

Handling Large Quantities of Lumber at Low Cost

POWER operated equipment of the character shown in the accompanying illustration not only handles large quantities of material but also places it exactly where it is wanted and stacks lumber in stock in a manner leaving it readily available for recovery at any time at the lowest possible handling cost. The hoist may be run onto a transfer bridge and moved to a point opposite the ends of spur runways to be run again onto a spur or branch line where a wide area is to be covered. Switches may be employed to transfer the hoist from one runway to another. It is also possible to lower a unit stack of lumber onto a truck for shipment or for transfer to locations not covered by the monorail system.

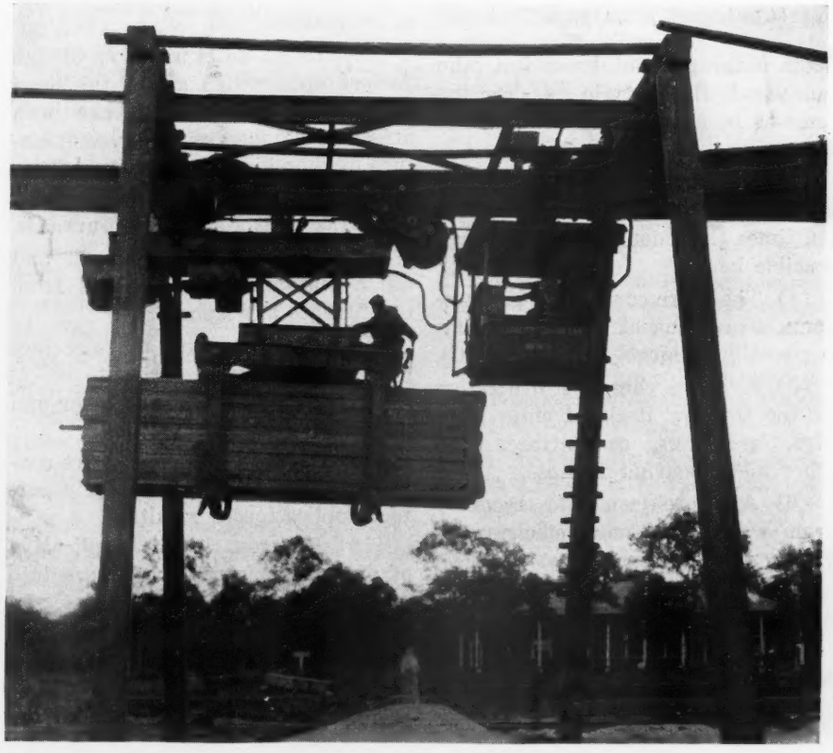
Mechanical handling, because of the large quantity of lumber that can be moved by a single operator, greatly reduces the cost of all operation. In addition to this cost reduction it also reduces damage to material and increases the ease and speed of filling rush orders. Special grips attached to the hoist through a turntable, together with other refinements, reduce to a minimum the actual labor required in the various hoisting, carrying, storing and recovery operations.

The illustration shows a portion of the lumber handling equipment installed at the mill of the Carpenter-O'Brien Lumber Company, Jacksonville, Fla. The monorail hoist is of standard type, being of a style used in a number of mills. It has a vertical lifting speed of approximately 50 ft. per min., and a horizontal traveling speed of 450 to 500 ft. per min. Such equipments handle unit packages or stacks of material in quantities of 1,500 board feet, as compared with the manual handling of only two or three per cent of such a quantity.

The equipment illustrated was manufactured by Pawling & Harnischfeger of Milwaukee, Wis., and represents a special line of material-handling equipment developed particularly for service in the lumber industry. When the runway passes through a building, the building structure is usually employed as a support, instead of erecting A-frames as in out-door work.

Lumber is handled in units of 1,500 board feet or more by aid of monorail system.

Finished lumber is at best a bulky and difficult material to move. By stacking boards in a unit pile, lifting the pile with a hoist provided with special grapple hooks, and then moving the hoist along an overhead track system the most difficult problems of handling are provided for.



Work Where the Electromagnet Soon Pays for Itself

EVERY time scrap iron has to be handled between its source and the point where it is melted for reuse, the cost of that handling must be subtracted from the value at the melting furnace to determine the value of the material at the source. Practical experience has shown the electro-magnet to be an effective piece of equipment in reducing this cost.

The handling ability of a magnet varies with the type of material being moved, the greatest capacity being attained with large, regular pieces of metal, such as billets or slabs. A small 20-in. magnet of a particular type taking approximately 2 kw. to operate, can handle loads of from 75 to 250 lbs. of scrap or pig iron and from 3,000 to 3,500 lbs. in the form of an ingot, billet or slab. A similar type of 40-in. magnet with a power input of 7.5 kw. will lift 500 to 1,300 lbs. of scrap or pig, and 15,000 to 30,000 lbs. of ingot, billet or slab material. The 60-in. magnet with an input of 18 kw. has a scrap or pig capacity up to 2,900 lbs., an ingot capacity of 25,000 lbs. and a slab capacity of 50,000 lbs.

Electromagnet mounted on crane to expedite handling of scrap iron into and out of stock.

A single operator only is required to manipulate this type of equipment for the handling of iron. The crane operator picks up and drops the load by simply manipulating the magnet switch mounted with the crane control apparatus. Magnets pick up much smaller loads of scrap material than they do of large flat pieces that offer good contact areas.

When scrap material is being handled, it is necessary to operate the crane at higher speeds than usual in ordinary practice in order to get a good daily tonnage. Cranes of 5 or 10-ton capacity are usually used for scrap iron handling, with hoisting speeds in ordinary practice running from 25 to 35 ft. per min. Much higher hoist speeds may be used if the crane is suitable for the service, speeds of 60 ft. per min. or more being recommended by some crane manufacturers. Trolley speeds of 150 to 175 ft. per min. and bridge speeds of 400 to 500 ft. per min. are also recommended by some crane experts.

The Electric Furnace

(*Continued from page 19.*)

know nothing about brass but who can watch the electric furnace the same as he can any other automatic apparatus.

(3) The melting of high-quality brass and bronze in ton lots, or about ten times the amount of the average crucible heat.

(4) The more convenient and economical handling of charges consisting wholly or largely of new metals.

(5) A more complete utilization by the foundry itself of chips, borings, grindings, concentrates and other metal-bearing wastes.

(6) A more complete recovery from wastes and more efficient salvaging from junk metals.

(7) Elimination of the laborious and expensive speltering process.

(8) The introduction of mechanical charging methods.

(9) Elimination of fuel storage and handling as well as the necessity of disposing of the gases and ashes of combustion.

(10) Exact determination of the factors upon which successful brass melting depends, which have been unknown because of the inexact nature of the older processes.

(11) Progress in the development of refractories for electric furnaces.

(12) Elimination of oxygen and other contaminating elements from the furnace atmosphere.

(13) Reduction in average net losses to less than 1 per cent.

(14) Reduction in hand labor and improved working conditions.

(15) More exact temperature control, permitting of more nearly perfect duplication of results.

(16) Progress in the application of direct pouring from furnace into moulds.

(17) Production of better average quality of metal.

(18) Reduction of over-all costs of melting copper alloys.

(19) Rapid disappearance of the crucible from rolling mill work and gradual reduction in its use elsewhere.

(20) Gradual restriction of open flame furnaces to a relatively narrow field of use.

Small Furnace Used to Fuse Enamel

FOR the heat treatment of steel and fusing enamel at 1600 deg. F. a small electric furnace installed in the factory of Bastian Brothers Company, Rochester, N. Y., has proved highly satisfactory. This company manufactures small jewelry and nameplates, a work which requires accurate temperature regulation. The furnace is compact and self-contained, the desired operating temperature being maintained by adjusting a rheostat and watching a pyrometer. No auxiliary apparatus is required for control. The only permanent connections are those which supply the energy to the furnace.

Editorial Plan and Its Scope

(*Continued from page 6.*)

no place in the conduct of modern work and are most expensive.

(2) They must see that equipment under their supervision does all that it was intended to do when operated by expert attendants under the best of conditions.

(3) They must install, operate and test apparatus concerning the design of which they may have little technical knowledge.

(4) They must solve electrical and mechanical problems brought about by new or changing conditions.

(5) They must make repairs and perform overhauling operations they have never met with before in emergency cases.

(6) They are expected to devise means to secure improved economies year after year as the plant grows and complexity of operations likewise increases.

IN SEEKING to aid in controlling the production cost of a product, whether it is a yard of cloth or a sack of cement, the following fundamentals will be considered in all discussions:

(1) Costs and economies of production depend upon methods of operation.

(2) Costs cannot be controlled until methods are under control.

(3) Methods cannot be controlled until the best methods are thoroughly known and the details of carrying them out are familiar to those who must perform the operations.

WE ARE then primarily interested in operating procedure that will make possible maximum results in the handling of materials and machines and in the continuity of operation in the various departments of all industrial works. Today the technical and development side of electrical operations is far ahead of standards of operating practice. A few instances only will suffice to make this point clear. Standards of industrial lighting are far behind lamp development and it is only recently that industrial engineers have learned to look at the lighting problem with a new interest, to find that under new standards the quantity of industrial output can be increased and its quality improved. Furthermore, it has been shown that the morale and the welfare of the worker is bettered thereby.

IN THE case of motor applications the standards of performance and design have developed far beyond standards of their applications to machines. The routine of inspection and the overhauling of equipment is only partially formulated in the larger works, while the procedure in many of large size is still conducted by rule of thumb. It will be the mission of this publication, therefore, to study the growing complexity of operating conditions, to analyze and to formulate the best results of operating practice, showing what can be done by what has been done, and the possible economies of different types of apparatus under varying conditions. It will analyze operating systems and details of methods which are being used that can be easily applied by the industrial workman who knows how to take advantage of the experience of the other fellow. In this connection the viewpoint in discussions will be worked out on the theory that a chain, although well designed and carefully made, is only as strong as its weakest link. However much the designer knows about working iron and producing chains will avail him nothing in the production of efficient chains except he knows where and how the chains are used and he thoroughly realizes the seriousness of the failure of one link.

Trade Literature *you should know about*

Ward Leonard Electric Company, Mount Vernon, N. Y.—A small booklet showing various types of vitrohm (vitreous-enameled) field rheostats. A four-page leaflet covers the Ward Leonard automatic starter, counter-EMF style.

Connecticut Electric Manufacturing Company, Bridgeport, Conn.—A new pocket-size catalog (No. 6) covers the "Up-to-date" electrical supplies of this company.

Patton-MacGuyer Company, Providence, R. I.—"Metal Stampings" is the title of an eight-page folder distributed by this company, covering its wire terminals, cable lugs, fuse parts and special stampings.

Ideal Electric & Manufacturing Company, Mansfield, Ohio—Bulletin 106 covers various types of "Ideal" motor-generator sets. Bulletin 107 covers different types of motor-driven electro-plating sets.

Oakley Chemical Company, 22 Thames Street, New York City—A small booklet describes the use of "Oakite" for cleaning waste and wiping cloths in machine shops, metal-working factories, etc.

Standard Scientific Company, West Fourth and Barrow Streets, New York City—Bulletin 18 describes carbon-compression rheostats, direct-current meter-loading units, thumbar terminals, binding posts and connectors.

Henry D. Sears, 80 Boylston Street, Boston, Mass.—"Weber Wiring Devices" is the title of the 1921 catalog issued by this firm.

Reflector & Illuminating Company, 565 West Washington Street, Chicago, Ill.—Bulletin 10 describes the "Flood-O-Lite" projector and contains a table showing the light flux at various distances away from the projector.

James B. Prouse Company, 37 North 6th. Street, Philadelphia, Pa.—A booklet is being issued describing insulated brushes and insulated scoops.

Beaver Machine & Tool Company, Inc., 625 North Third Street, Newark, N. J. A folder describing the "Beaver" switch plug, "Feed-thru" switches, couplings, etc.

E. J. Codd Company, 700 Carolina Street, Baltimore, Md.—Patent-chain screen doors of the "Wiegand" type for furnaces and ovens are described in a recent booklet.

The Dahlstrom Metallic Door Company, Jamestown, N. Y.—A twelve-page booklet describing "Condue-Base," which is a combination metal base, electric conduit for low-tension and high-tension wires and a continuous electric outlet-box.

David W. Onan, 43 Royalston Avenue, Minneapolis, Minn.—The "Onan" lathe and mica undercutter is described in a recent leaflet.

Tindal & White, Inc., 329 East 22nd. Street, New York City—A circular describes the "Perfection" shade for electric lamps.

Conveyors Corporation of America, 326 West Madison Street, Chicago, Ill.—A circular describes the "American"

air-tight door for ash pits, boiler settings, coke ovens, etc.

American Steel & Wire Company, Chicago, Ill.—A bulletin describes two recently developed resistors for welding rail bonds.

Triplex Machine Tool Corporation, 18 East 41st Street, New York City—Catalog 1 describes the Triplex No. 1 machine tool, a device with a built-in motor for turning, boring, milling and thread-cutting and for drilling at any angle to its bed plate.

Harvey Hubbell, Inc., Bridgeport, Conn. —In Bulletin 17-4a is shown a composition cap with tandem blades for plugging an extension cord into a convenience outlet. Slots in the cap permit another cap to be plugged into it, thus allowing two cords to be supplied from one receptacle. The device is called a "Te-Cap."

Robbins & Myers Company, Springfield, Ohio—An improved line of alternating-current and direct-current desk and ceiling fans is covered in domestic Catalog 1177.

Wagner Electric Manufacturing Company, St. Louis, Mo.—Bulletin 129 explains the features of the "Pow-R-full" line of polyphase motors.

Black & Decker Manufacturing Company, Towson Heights, Baltimore, Md.—A bulletin describes a special half-inch drill with pistol grip and trigger switch.

Repel Arc Furnace Company, Indianapolis, Ind.—A new arc furnace of the repelling-arc type, which can be connected directly to a 220-volt power line without special transformers, is described in Bulletin 302.

Hisey-Wolf Machine Company, Cincinnati, Ohio—A new line of electric drills with universal motors is described in Bulletin 105-A. Special features of the drill are ball bearings, quick connector and forced ventilation.

Holophane Glass Company, 342 Madison Avenue, New York City—Bulletin 343 describes the Holophane light-meter which is designed for taking measurements of light intensities in a very simple manner, without calculations.

United States Electric Company, New London, Conn.—Bulletin 6 describes and illustrates various types of electrict rivet-heaters.

Cincinnati Hy-Speed Machine Company, Cincinnati, Ohio—Circulars have been issued covering the "Hy-Speed" drilling and automatic tapping machines.

Chicago Pneumatic Tool Company, Chicago, Ill.—Bulletin 710 describes the steam, belt and motor-driven pneumatic dry-vacuum pumps made by this company. Special publication 674 covers various types of pneumatic tools.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.—Catalog 12-A describes various types of safety switchboards and panels.

Whiting Corporation, Harvey, Ill.—Catalog 158, superseding 151, describes standard crane designs and also contains several tables of standard clearances.

Clements Manufacturing Company, 609 Fulton Street, Chicago, Ill.—A folder called "Fights 'Dustruction'" covers the "Cadillac" portable electric blowers which this company makes.

Imperial Electric Company, Firestone Park Station, Akron, Ohio—Two recently issued circulars cover various types of motors and generators.

Armature Coil Equipment Company, 3202 Scranton Road, Cleveland, Ohio —A recent announcement describes a new pulley-driven, coil-winding machine.

Harvey Hubbell, Inc., Bridgeport, Conn. —Bulletin No. 17-5 describes several new devices added to the line of this company, including interchangeable "Knostrain" plug caps, polarized cord connector, round flush receptacle and separate red lamp for Hubbell "Signalite." A four-page leaflet describes toggle flush switches.

Pawling & Harnischfeger Company, 38th and National Avenues, Milwaukee, Wis.—Bulletin 56-X describes the use of excavators under various conditions of service and application.

Ilg Electric Ventilating Company, 2850 North Crawford Avenue, Chicago, Ill. —A recent circular describes various types of Ilg self-cooled, motor-propelled fans and blowers.

Aero Alarm Company, 26 Cortland Street, New York City—A booklet has been issued covering an automatic fire alarm.

Harvey Hubbell, Inc., Bridgeport, Conn. —Bulletin 17-2 describes the new "Hubbell" single and duplex flush door-receptacles.

Lakewood Engineering Company, Cleveland, Ohio—A booklet is being distributed showing the various types of storage-battery trucks for use in industrial and manufacturing plants. It is called "The Unbelievable 30%."

Industrial Works, Bay City, Mich.—An announcement relates the development of the type BC "Industrial" crawling tractor-crane.

Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, England—Special publication 785/5 deals with the choice of motors to be used in industrial work.

Charles Cory & Son, Inc., 183 Varick Street, New York City—Bulletin 101-29-A covers the "Cory-Record" ohmmeter, which is used for measuring the resistance of circuits by one direct reading.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.—Folder 4474 covers the Westinghouse lead-base babbitt metals.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—Bulletin 1108 covers various types of power transformers.

Westinghouse Lamp Company, 165 Broadway, New York, N. Y.—Bulletin E-101, called "Illumination Values and Their Measurements," contains tables of present standards of desirable illumination for various classes of service, illustrations of illumination-measuring instruments, etc.

Allis-Chalmers Company, Milwaukee, Wis.—Bulletin 139 describes and illustrates a line of power machinery including a line of motors for use in textile mills.

Norma Company of America, Anable Avenue, Long Island City, N. Y.—"Good Fractional Horsepower Motors Made Better" is the title of a booklet describing the application of "Norma" precision ball bearings to small motors.

Ward Leonard Electric Company, Mount Vernon, N. Y.—A small book covering loading rheostats has been issued.

Sangamo Electric Company, Springfield, Ill.—Bulletin 58, which supersedes Bulletin 50, describes the locomotive type of ampere-hour meter with mercury-supported disc.

Stromberg Electric Company, 209 West Jackson Boulevard, Chicago, Ill.—Bulletin 214 describes "Process" timing and signaling instruments which have recently been placed on the market.

Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.—A leaflet has been issued describing the "Lift-About," which is a small electric hoist intended for use in mills, factories, warehouses, stores, etc.

The Peerless Electric Company, Warren, Ohio—Bulletin 37-A covers direct-current "Multipolar" motors and generators.

Mercury Manufacturing Company, 4118 South Halsted Street, Chicago, Ill.—"The Trackless Train for Textile Mills" is the name of a new bulletin which tells of a new Mercury tractor, type K, designed particularly for work in textile plants.

Despatch Manufacturing Company, Minneapolis, Minn.—Bulletin 3, containing 36 pages, describes a complete line of ovens for heating, baking and other general purposes. A small oven with three-heat control and temperatures ranging from 100 to 400 degrees is a new product of this company, designed for baking and drying enamel on small parts, for baking armatures of small motors and the like.